ELECTRICAL ENGINEERING

MARCH 1944

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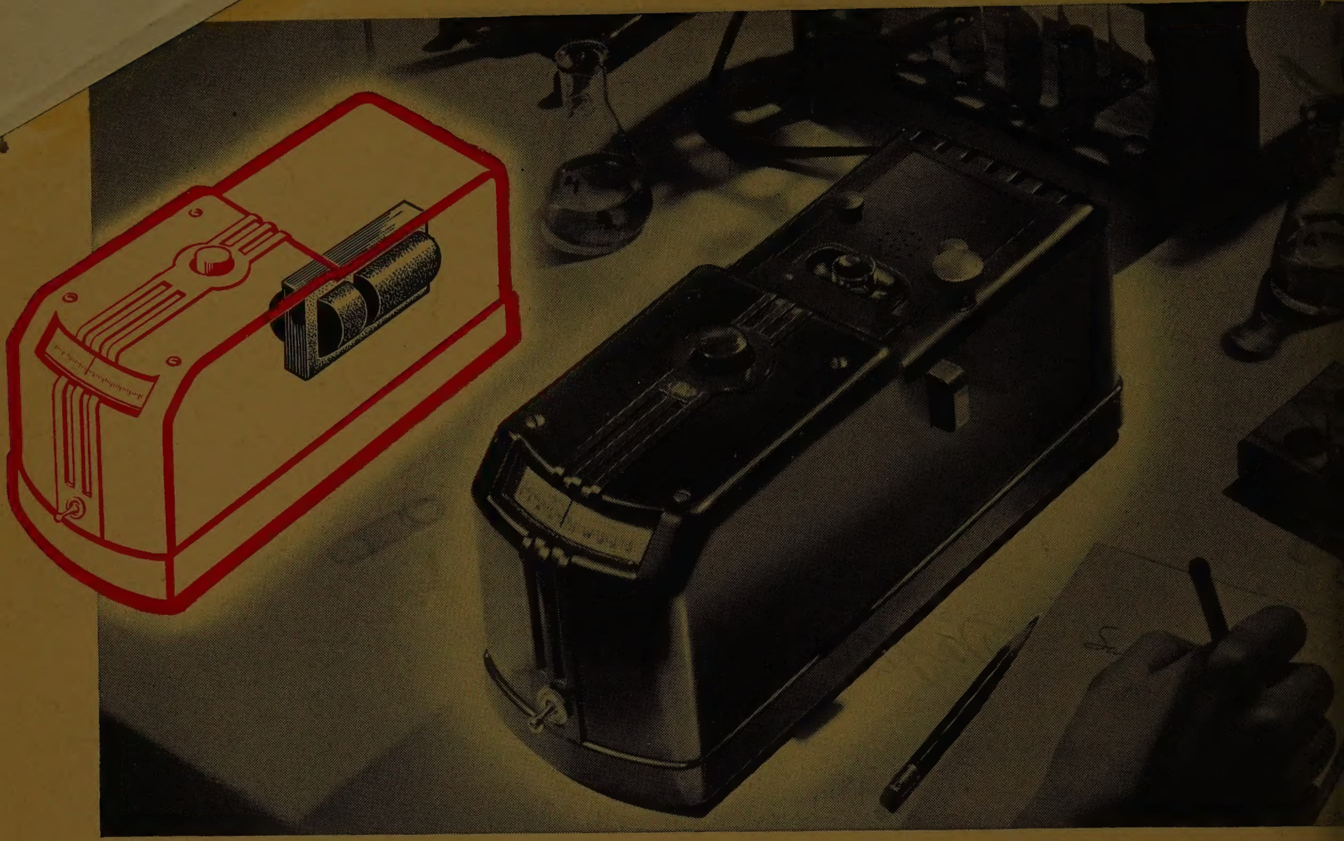

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ELECTRICAL ENGINEERING

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MARCH
1944

The Cover: New 50,000-kw Mystic generating station of the Boston Edison Company

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LECTRICAL ENGINEERING
OLUME 63, NUMBER 3
MARCH 1944

A Postwar Economy for the United States

WILLARD CHEVALIER

The outcome of the struggle between the collectivists and the individualists will be determined by the people of the United States on the basis of the performance of business during the first few years after the war, says this author. A high-level employment, a high-level production, and a high-level efficiency are the three standards he recommends as the foundation of an expanding postwar economy.

MORE AND MORE of our American businessmen must become interested in the necessity of doing me postwar planning, of doing it now, and of being epared to put those plans into effect just as quickly as ssible when the time comes.

Postwar planning is one of the aspects of this period of r war development that had no counterpart during the st World War. Perhaps the ason we were not over-con- rned with postwar planning is that our post-Armistice scussions showed none of the sgivings and spirit of de- tism that exists today.

This time we seem to be rfeited with defeatism. We rt off with the assumption at there is bound to be mendous unemployment, d we talk about endless naceas to cope with this evitable unemployment. Why? What is the reason the difference?

During the decade preceding our entrance into the r we had been suffering from an utterly abnormal pression of the American spirit as well as of the American onomy. We cried out for all sorts of needles to stimulate once again, but none of the needles seemed to work, cause the patient himself had lost so much of his vitality. w with a situation so different from what it was during 30's, as we approach a period of enormous accumu- ed shortages and enormous available purchasing wer, we are still living in the psychology of defeatism at governed us in the 30's. Instead of looking forward the opportunities ahead, we are brooding over the blems that bothered us during the 30's and wondering at we are going to do about them when the war is over.

COLLECTIVISM VERSUS INDIVIDUALISM

One of the reasons we have lost our faith to such a gree in the spirit of American enterprise and the oppor- ities of American life is that for some 15 years through- t the world there have been a great many outbreaks a doctrine of collectivism as a means of regularizing d controlling the economic life of nations.

This doctrine of collectivism has appeared under many different forms in many lands. One of them was the refurbished tinsel Roman imperialism of Mussolini under the name of Fascism. Another was the vast Wagnerian racketeering of Hitler and his Nazi clique. Even our professional brethren discovered their particular form of collectivism all wrapped up in a technical Mumbo Jumbo of one kind or another. Collectivism in some form or another seemed to have taken hold of people the world over as an easy way out of their economic troubles.

However these outbreaks may have varied in their superficial terms, they had one aspect in common. That was the existence of a small, self-appointed, and self-perpetuating group of know-it-alls who were prepared to plan the economy and direct the productive energies of the rest of the people in their society, be it nation, community, or whatnot. That little group of know-it-alls was the common denominator of all these various forms of collectivism.

There may well be a justification for this collectivist phenomenon in order for example, to shift a nation such as Russia bodily from the agricultural peasant economy of centuries to a new industrial economy, in the shortest possible time. Or when a nation stands with its back against the wall and must fight a war, for either defense or conquest, and all the productive energies of a nation must be mobilized for the one purpose of waging war under the single-minded direction of a government, then, too, there is a place for collectivism—indeed, a very essential place.

But it does not seem that this collectivist concept has had anything to offer the American people that would be superior to what they have had now—that is, the philosophy that has produced an Edison, a Westinghouse, a Doctor Bush, and all the rest of those that we, as engineers, delight to honor.

However, this issue of individualism versus collectivism is very much in our minds today. A large part of the defeatism, this uncertainty and worry about what the postwar period is going to bring us, arises from the fact that the war began during this debate of the '30's, and a great many of us are not yet quite sure what will be the outcome of that debate in the minds of the American people. We are beset by an uncertainty and a concern that grows out of this issue of individualism versus collectivism.

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ntial substance of an address delivered at the general session of the AIEE winter nical meeting, New York, N. Y., January 26, 1944.

ard Chevalier is vice-president and director of McGraw-Hill Publishing Com- , Inc., New York, N. Y., and publisher of *Business Week*. He served as enant-colonel of the 11th United States Engineers during World War I.

I have a feeling that the first few years following this war are going to determine that issue for at least a generation, or maybe two generations or more, in the United States. The significant thing to us, as businessmen on the one hand, and engineers on the other, is that this issue will be settled not by any debate on ideology but on the cold stark basis of performance. And the judges who will sit in judgment are the people of the United States, not the professional groups, not the business groups, not the industrial groups. The issue will be determined by the American people, on the basis of the performance of the first few years following the end of the war.

THE COLLECTIVIST'S HAND

Now then, let us take a look over the shoulders of both parties to this controversy and see what kind of cards they hold. When we look into the hands of our collectivist friends, we find that the best cards they have are the undoubted deficiencies and abuses that have grown up in the conduct of business, especially corporate business, over the years—deficiencies that have tended to limit competition, restrict production, and prevent our system from delivering the largest possible benefit to the greatest number of people. I do not imply for one instant that that end was deliberate or intentional, but, nevertheless, there were in the operation of our system, certain practices that needed corrections.

Another face card in the hands of the collectivists was the collapse of 1929, the enormous mass employment, the great human distress that came about from what they are pleased to call the collapse of our system. I am not underwriting that description. I am merely quoting it.

Another high card they have in their hands is the punitive measures of regulation, taxation, and employment, that resulted in the '30's from public resentment at the distresses that we were called upon to bear as a result of the collapse of '29. Those who deal in the commodity of politics are always ready to make hay out of whatever they may find growing, and, if they find resentment, unhappiness, and misery then these become the things to harvest and make hay of. Lord knows there was plenty of hay made out of the resentment of the American people during the '30's. We had a state of regulation, control, statutory enactment—much of which was salutary, some of which was overdue, but a very large part of which was purely punitive in its intent and in its effect upon the operation of our system.

Another face card in the hands of the collectivists is the concept of the mature economy, the idea that we had gone as far as we could go, and from now on we would have to administer more and more closely and regulate more and more rigidly all of the little trickle of resources that we had already developed in the United States.

And then another high card in the hands of the collectivists is the increasing political power that they have succeeded in gathering over these years as a result of these developments of which I have already spoken. And another, of course, is the fact that we have been compelled to invoke a collectivist economy for the purpose of waging war, and the question comes up "If it does a good job in war, why shouldn't it do a better job in peace?"

Finally, we have the very large Government investment in the various forms of productive activity, again as a result of the war, which puts a card into the hands of our collectivist friends. When you add all of the accumulated worries and uncertainties that beset the industrialist and the businessman of today, as he contemplates the future and tries to bolster up his courage to the sticking point to fulfill his traditional role as the risk taker, the adventurer, the economic explorer, you see that our friends, the collectivists hold a fairly strong hand.

Now let us take a look at the hands of our friends who do not believe it's necessary to have recourse to collectivism to salvage America after the war.

THE INDIVIDUALIST'S HAND

The individualist's hand has its face cards, too. In that hand is the best ace in the deck—that the American system, for all its defects, its deficiencies, its theoretical puzzles, and its practical abuses, has given the American people the highest standard of living that any people, anywhere in the world have ever enjoyed.

Another big card is the record of industry in this war and the altered public attitude toward industry as a result of its incomparable achievements in the war. I remember so vividly in the early days of our defense effort how fearfully American industry was on the defensive. I remember the vicious and vitriolic charges that were thrown against it for its profiteering and its unwillingness to go all out for war and its efforts to evade its responsibility. It seems hard to believe that that was only a couple of years ago when we contemplate what has happened since.

Another high card is the fact that we have had an enormous acceleration of technical progress during the war. Our technicians have given us new powers with which to work. Our industry has new tools with which to tackle this postwar job.

Another high card is the reactivated confidence of industry in its own productive capacity. We have a new faith in ourselves, a new belief. We have the complete answer to the notion of the mature and finished economy that is bumping up against the ceiling of its potential. We have pushed that ceiling up until it has disappeared into the ethereal, and today the American businessman and industrialist recognize no limitations upon their productive capacity if the conditions and the demand be right for them to go ahead.

And then another high card that I see is the political reaction that we have among the American people against the excesses of the extremists who find themselves in power and who try to sell the collectivist bill of goods.

But the biggest card, next to that one outstanding fact of the accomplishment of our system, is that the American people are coming to understand what is meant by a planned economy. They are beginning to learn that economies cannot be planned in a vacuum, but only in the lives of the people who live under those economies. They have been brought up on the notion that a planned economy implies only that industry and the businessman will be planned, and that Joe Doakes, Mrs. Doakes, and the little Doakes will go on being just the same kind of American Doakeses they always were. Now they are beginning to realize that, when the planner begins to plan an economy, he has to plan the production of that economy. That means he has to plan where Joe will work, what he will produce, how long he will work, and what he will get paid for it. And even more, the planner will plan what Joe can buy when he goes down to Main Street with the dollars that the planner has given him fo itting in his time working on what was planned. Joe beginning to realize, in other words, that economic anning includes him.

Now the American people are alive to what a planned onomy means, and they do not like it. They are rfectly willing to put up with it for the sake of winning war, but they want to get it over with so that they can t back to living their American lives.

And, incidentally, a high standard of living is not cessarily just a matter of having an abundance of aterial things, not nearly so much as having the complete edom of choice as to what you as an individual will oose from this great abundance. What constitutes e of the elements of the American standard of living that when you go out you can get what YOU want.

THREE YARDSTICKS

These are the cards that are held in the two hands. hat are the yardsticks by which the American people ll judge the performance? The first of these, in my dgment, is our ability to deliver a high level of employ- ent in this country, a sustained high level of employ- ent. I do not mean full employment. You can insure l employment only by means of a totalitarian planned onomy. This does not necessarily mean that the same ople are always unemployed, but there will always be measure of unemployment. When we talk about and omise full employment, we are talking about something ferent from the operation of a free people and a free onomy.

What I mean by high level of employment is that we ust have a scale of employment, a level of employment, high that there will be no distress unemployment, that ere will be no feeling of mass insecurity on the part of arge number of our people that they are not going to able to get jobs when they want them. And we must nember that our employment must be on a scale that l furnish opportunity for the individual who wants, and ble, to rise above the mass, to reach to higher levels of npensation and higher standards of living. We want cale of employment that will enable us to realize those ends: no feeling of mass insecurity as to distress employment, and still opportunity for the individual rise, because he shines in abilities and skills in com- ison with his fellows.

The second yardstick by which, I think, our people will ge our performance is a high level of production. much emphasis has been placed in recent months n this matter of high-level employment and not ugh on high-level production. After all, it will not p our unemployment problem to add the names of ple to payrolls, either public or private, unless they putting their energies into producing the things that needed in order to maintain their standard of living. imply putting people to work rolling peanuts down in Street and putting their names on payrolls will solve the unemployment problem, because it will give the people the things they need whereby to live. igh level of production is essential, because no people enjoyed a standard of living beyond their own duction. There is no source of production except brains and the labor and the work of the people nselves, and, if any individuals think that they, by process of payroll legerdemain, are going to be cut n the things that they did not produce, then they are simply taking away from someone else the things that he produced. There is no magical source of the things that people want except through their own efforts and their own labor. And so I put a high level of production as the second yardstick by which our people must judge performance.

And then the third is a high level of efficiency, higher perhaps than we ever have known. Efficiency in the sense of a greater amount of production of the things that the people need in terms of expenditure of human effort. We will have to carry an increased burden after this war. The only way one can carry an increased burden is by putting more value underneath it, and the only way to put more value underneath it is to make the expenditure of human energy count for more in the production of real wealth. Only in that way shall we be able to cope with the burden the war will leave us.

This high level of efficiency touches all five of the elements of our economy. First, it touches capital. Capital must realize that the time is past when, we in the United States, can afford to get rich by the simple process of multiplying pieces of paper. We must realize that if capital is to expect a return, capital must apply itself to truly productive effort in increasing our efficiency, that we cannot hope to build fortunes nor to get reasonably rich nor to accumulate competences merely by multiplying a number of pieces of paper that represent the extent of wealth. Capital must be efficient if we are going to have an efficient economy.

Next, technology must be efficient. We must press back inexorably, unremittingly, the frontiers of our scientific knowledge, and we must put that science to work just as fast as we can do it. We cannot have any holiday in the application of our scientific progress to the doing of useful things in the economy of which we are a part. Science must work, science must be efficient, and science must be employed continually in solving the problems that will confront us.

The next element that must be efficient is management. Management must lay aside the idea that it will prove its prowess by conserving what it has. It must be bold and aggressive and press forward always to new accomplishment, to new production levels, to new distribution triumphs of one kind or another. The idea of a conservationist management must be discarded if we are to achieve the high efficiency necessary to carry the postwar load.

Labor must learn that it too must contribute to efficiency. We must get out of the head of the American workman the notion that if he gets more out of the boss and gives him less he is putting something over on the boss, because when he gets more for doing less he is getting the best of no one but himself. In the long run he is going to have only what he produces, and, if he consistently works it out to get more laundry checks in his hands for producing fewer shirts, he is the one who will lose his shirt. We must get over the idea of restricting output in the fallacy that somehow or other we are helping ourselves in doing it; must learn that productive capital must be matched by productive labor, and that we must expect to get out no more than we put in. We can get more only by producing more and doing more.

Finally, we must have a Government policy that through taxation, through every means of regulation and control that it has, will stimulate the obsolescence of the old and the development of the new. If we are to expect capital to accept the obsolescence of the old that goes with constant improvement, then we must have a recognition of that policy through taxation and other regulatory policies of government. A premium must be put upon the adventurer, upon bold capital rather than timid capital, upon aggressive management rather than conservationist management. If we are to achieve this high efficiency, we must have highly efficient government policies as well as highly efficient business policies.

The responsibility of the engineer touches all of these. It is perfectly obvious that it touches technology. There is no need to dwell on that. It touches management less directly perhaps, but it is going to touch it more and more, because more and more the engineering attitude is going to pervade the decisions of management.

And so I say there are three yardsticks: a high-level employment, a high-level production, and a high-level efficiency, by which we are going to perform and on which performance the American people are going to judge us.

EXPANDING ECONOMY

It is 25 or 35 years since we have had a really great industrial expansion and renaissance in this country. But we will have to get back to that constant industrial expansion if we are to do the job that confronts us.

The basis of that job will be technical progress and higher efficiency in both production and distribution. Let me call the roll very briefly of the things that we will have to do and the parts into which this problem breaks down. You can write the engineer into each one of these in accordance with what measure you think he belongs there:

1. The development of new products.

2. The improvement of old products, in my judgment even more important than the development of new ones. Much emphasis is put upon these new products. But we are not going to build the American economy on all new products. It is the improvement of the old products, many of which, when improved, will be able to hold their competitive position even against the new ones, that will constitute an enormous part of the expansion of our enterprise.

3. The use of newly developed materials that have been strategic for the purpose of the war and that, sooner or later, will be released for use of civilian industry.

4. The development of constantly lower prices—in spite of all the elements of higher costs—in order to broaden our markets and to put more things within the reach of more people. That is one of the essentials of an expanding economy.

5. Modernized techniques will be necessary to make a competition more aggressive than we ever have known. If we are to throw the wraps off competition in American industry today, we will need the utmost resources of the engineer's genius and skill in order to pit producer against producer in giving the American people more for their dollars.

6. Speeded-up research, on a scale that we never have dreamed of before, research that will be made available to the small producer and the small industrialists, as well as to our great industrial organizations, is needed. And by that I do not mean Government-dominated research either. I mean research that will still be on its own as one of the exemplars of individual enterprise and individual opportunity.

7. The higher obsolescence of tools and techniques. We are going to have to learn that we have a vested interest in preserving just exactly nothing of the tools and techniques in an industrial economy. We shall have to learn the philosophy that, when we send the sales manager and the production manager out of one door with a new product, we will call in the research man and the designing engineer from another door and say "put that thing out of business just as quickly as you can, before our competitor puts it out of business for us." And we shall have to recognize that nothing has a right to exist until it can continue to compete in a free market for the preference and favor of the American people.

8. We shall have to develop merchandizing and distribution that will seek to foster the wider use of products and to broaden the markets rather than, somehow or other, to elbow out everyone else from the market. In other words, we must learn how to merchandise and distribute our products by baking bigger pies instead of by merely getting a bigger cut for ourselves. That is one of the essentials of an expanding economy.

9. Finally, a new concept of public and labor relations will be an essential of this expanding economy, because, as I have tried to suggest, it will be exceedingly difficult for any of us to develop an expanding economy in the United States if we do not have with us the technicians, the industrial managers, the working men, the Government, and the people at large. Just as long as any one of those elements is holding back, we will not be able to achieve the kind of an expanding economy necessary for us to meet the challenge of the postwar period.

I have not said a word as to just where the engineer fits into this picture. You know the answer to that as well as or better than I do. All that I have tried to do is to paint a picture of a situation and to throw out a challenge to professional engineers to rise to take the greatest possible place in that picture.

Edison's Dream

February 11 commemorated the 97th birthday of Thomas A. Edison, one of the greatest of Americans and the supreme inventive genius of the industrial age. The staggering list of his inventions compels us to realize the extent of his contribution to the United States and to the world, not merely in our own days, but for all time to come. Already he has, through the disciplined activity of his ideas, produced billions of dollars of new wealth.

Much more important than the new material wealth which his inventions have brought forth are the new paths in the pursuit of human happiness indicated by them. He sought the secrets of nature and devised the means to exploit these secrets in order that they might be applied for the betterment of man. What seemed even more important than genius was his extraordinary capacity for unflagging hard work, which led him to "scorn delights and live laborious days." He refused to accept at any time the idea of defeat and regarded the failure of an experiment as merely an incitement to further effort. He believed with the poet that "we fall to rise, are baffled to fight better."

His life and example give us courage to make a better world, to turn our increasing control over nature away from the works of destruction into the labor of creation, away from ugliness into the development of beauty. We learn the secrets of swiftness, power, and light, utilizing unseen forces hitherto hostile and deadly, to make life not merely safer and easier but also more complete. That was his imaginative dream.

Excerpt from Edison broadcast, February 11, 1944, by Charles Seymour, president Yale University, New Haven, Conn.

Vannevar Bush—1943 Edison Medalist

1944

THE AIEE's highest honor, the Edison Medal, was awarded for 1943 to Doctor Vannevar Bush (F '24) president, Carnegie Institution of Washington (D. C.), and director of the Office of Scientific Research and Development, for "his contribution to the advancement of electrical engineering, particularly through the development of new applications of mathematics to engineering problems, and for his eminent service to the Nation in guiding the war research program."

Presentation was made at a special session of the 1944 winter technical meeting of the Institute, New York, N. Y., January 26. Chairman W. B. Kouwenhoven of the Edison Medal committee outlined the history of the medal, which was established by a group of friends and associates of Thomas A. Edison to serve "as an honorable incentive to scientists, engineers, and artisans to maintain by their works the high standard of accomplishment" set by Edison himself, and which is awarded annually by a committee of the AIEE to a resident of the United States or its dependencies or of the Dominion of Canada "for meritorious achievement in electrical science, electrical engineering, or the electrical arts." The qualifications of the medalist were described by AIEE Past President Frank B. Jewett (F '12). Presentation of the medal and certificate was made by President Nevin E. Funk, who presided at the ceremony.

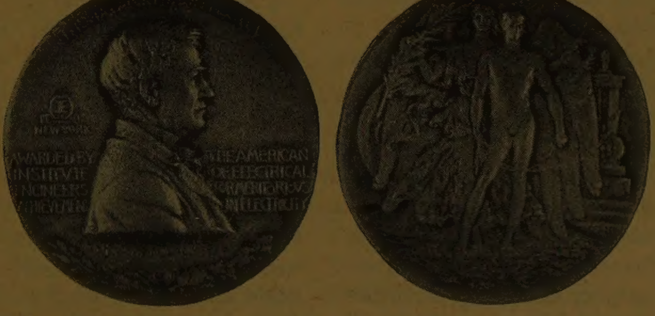
Essentially full text of Doctor Jewett's address and Doctor Bush's response follows.

The 1943 Medalist

FRANK B. JEWETT, Past President AIEE

If any of you, at the conclusion of my remarks, feel that I have handled the presentation of the 1943 Edison Medalist in an unconventional manner, I can only reply that Doctor Bush is a somewhat unconventional man. Further, for more than 25 years my association with him has been far from conventional.

When one looks over the names of the 33 men on whom the AIEE has bestowed its highest honor since the first presentation to Elihu Thomson in 1909, it is as though there were unrolled before him a moving panorama of the development of electrical engineering and the great industries to which it gave being. Here, roughly, in proper sequence of time, are the names of men who in their day made noteworthy contributions to one or another of the varied components of which the intricate structure of applied electricity is built. The scientist and teacher, the mathematician, the industrial-research director, and the great inventor are mingled with the great engineer as we commonly think of him—the man who combined several claims to our homage—and others whose great contributions were the creation of vast industries in the field of applied electricity to serve the needs of society.



Edison Medal, highest award of the AIEE, established February 11, 1904, and presented for the first time in 1909

From the vantage point of a greater distance of time it may seem, in some cases, that here and there a man was denied too long the honor of his award. In a way, however, the delay was testimony to the lasting value of his contribution.

For those of us who knew these men intimately the individual pictures thus conjured up are not so much pictures of scientific or technical achievements as pictures of men against a background of their work and the influence they exerted. Generally, the background is like that of a New England landscape—many modest hills and pleasant valleys. Occasionally, however, it is austere, and one in which a high peak or two dominates the scene and tends to deflect attention from the man toward one or more of his outstanding contributions.

Into this kaleidoscopic pattern of our recognition that men of many talents in many fields have contributed signally to the warp and woof of our profession, it is particularly fitting that we should add the name of Vannevar Bush and that we should add it at this time. As scientist, teacher, inventer, designer of powerful mathematical tools which have lightened the burden and expanded the possibilities of engineering generally, and as a distinguished director of scientific research, he has earned for himself not only a high place in the ranks of American scientists and engineers but likewise, and justly, the right to be the nation's scientific leader in this time of great national danger.

So varied are the fields to which he has turned the attention of his fertile mind, and so uniformly has that attention served to enrich them, that a poll among those who know him and his work would develop a startling diversity of opinion as to first place in the order of his claims to distinction. One has but to go through the titles of his published papers and addresses and the long list of his patents to be impressed by the catholicity and power of his mind. Those of us who know him well, however, know that the published record represents but a small fraction of his diversified interests. There is little or nothing in this published record of his equipment for automatically regulating the proper sprinkling of plants in a greenhouse; of his experiments in photography and with viviparous tropical fish; of his prowess as a navigator and skipper of ocean racers, or in the scientific commercial raising of turkeys. These and many others, I suspect, he looks upon as relaxation avocations.

If you are interested in forming an appraisal from the permanent record you must supplement the list of his scientific and technical work—largely in the field of electricity and engineering—by his contributions to technical education and its administration. You must read his reports on the patent system, his testimony before Congressional committees, and, above all, his annual reports as president of the Carnegie Institution of Washington.

It is a far cry from the ability required to design apparatus for transferring heat mechanically, or a lubricating system for vehicle wheel bearings, to that required to conceive and design the most powerful mathematical engine ever devised. By all customary standards it is a farther cry still from the type of mind which can devise a new electronic tube or a complicated radio set to one which can administer and direct creatively a great diversified fundamental science undertaking like the Carnegie Institution. Beyond that even is the greater gap which separates the quiet of the laboratory from the turmoil of the directorship of the Office of Scientific Research and Development of a nation at war, where all that is potential in civilian science and technology has to be forged for a maximum of conflict power in a minimum of time and with a minimum of conflict in the forging, where the job to be done is only partially one of dealing with inanimate things and largely one of dealing with strong and frequently perverse men. I never cease to marvel at a man who in days filled with such turmoil can find the time and, above all, the philosophical detachment needed to formulate a state paper like the recent letter to Senator Kilgore on the problem of technological mobilization.

Even if time permitted, I am not competent to appraise and judge most of Doctor Bush's scientific contributions, except insofar as they can be judged by their end results. Rather, I find it pleasanter to deal with the man himself as I know him.

I first came to know Vannevar Bush at New London, Conn., during World War I, when, as a young man, he came to the antisubmarine laboratory. Even then I was struck with those characteristics which I was to find later were the hallmarks of the man—a brilliant versatile mind; an intense interest in and curiosity about everything that came within his ken; an uncanny ability to illuminate the dark corners of any matter to which he gave his attention; his fairness, simplicity and lack of ostentation; and, above all, his complete intellectual honesty.

While I know he wasn't born there, I always think of Bush as a Cape Codder. His roots are deep in the soil of that historic bit of sterile land on which our forefathers landed, and, metaphorically speaking, his shoes are full of its sand. Like thousands of others before him who have gone a pioneering on land and sea, he returns there periodically to replenish that sand and so insure keeping himself a realist in a too frequently unrealistic world.

Better than most men he can fight vigorously with any of the weapons men employ and do it without rancor. I have yet to see a case in which there was any aftermath of hard feeling or in which the feeling of respect and affection for him was not enhanced in the erstwhile antagonist.

In closing, I can only hope that I have not led you to think that he is a man who never makes mistakes. Even if I thought so I would scarcely dare make public proclamation of the fact, since I must protect my right to differ violently with him if occasion arises, as I know it will.

What I have sought to convey is the impression of a very able, very human man in whom are combined great ability, great energy, a great sense of reality, and the power of absolute truth, together with all the common qualities of men, including an ability to make mistakes. Unlike many men, he can and does admit error without losing face either with himself or anyone else; rather, he enhances it.

While I have no quarrel with the citation which accompanies the medal, and while I appreciate the limitations imposed by brevity in such matters, I cannot escape a feeling that the words chosen limit too narrowly the basis of his contributions which we seek to signalize. He is a great scientist and engineer, a great teacher and administrator, and a great American in a sense that no few words can encompass. To me that greatness is the greatness of many positive personal contributions and a host of others which his leadership has inspired.

In selecting Doctor Bush as the 1943 Edison Medalist the AIEE has shown great wisdom, and in making the award they have honored themselves as well as him.

The American Tradition of Opportunity

VANNEVAR BUSH, 1943 Edison Medalist

Thomas A. Edison exemplified an important aspect of American life. He combined, in superlative degree, resourcefulness and initiative with an intense practicality and a keen vision. The many results which he attained during his life sprouted from the blossoming of this combination of talent in an environment which was wonderfully adapted for such a growth.

I do not need to say to this audience that these are not the only characteristics that are needed in scientific and engineering endeavor. The list of Edison medalists is itself a demonstration of the recognition of the need for combining such qualities with scientific deduction, mathematical analysis, and the like, in order that there may be a rounded whole. Our great industrial advance, with its intense use of electric power and its intricate mechanization, has arisen by reason of the efforts of many types of mind. But without the important phase that Edison so notably exemplified the scene would indeed be a drab one.

The United States has prospered in a material way. It has attained a standard of living far beyond that arrived at in any other country. This is not entirely explained simply by the presence of great resources, or a large and uniform market, or even by the opportunities for pioneering that are summarized in the convenient term "the frontier." Neither does the opportunity for advancement necessarily vanish when the geographical frontier gives place to one that is entirely of a technical nature. The advancement has occurred because America brought a new idea into the world and because it was a valuable idea.

In a word, there was produced an atmosphere in which Edison could function, and in which men like him in having ideas and the intellect for their furtherance, however much they might differ from him as to method, could make their influence felt. The startling forward steps that Edison caused by his own efforts could not have occurred in a totalitarian state, whether the label were that of state cialism or Fascism or something else. They could have curred fully only under the unusual state of circum- nces which obtained in this country when Edison worked d created. The atmosphere that existed is hard to fine; it had its crudities, but it was a unique atmosphere d it is well worth preserving.

As the United States matures, we are in distinct danger losing this enormous asset. The unwillingness to take ks which accompanies economic maturity, the cross- rrents of pressure interests, the mere increase of inter- pendence due to the advance of mechanization, all ld to destroy the flexibility and freedom of action which e essential parts of the atmosphere of individual creation.

To the trends that were molding our environment and nditioning the atmosphere within which our pioneers rked was suddenly added the impact of war. We awoke e from a period of lethargy to find ourselves in an in- nse struggle caused by the clash of our political and cial philosophies with ideologies far different from our n. When the war ends the read- tment will be difficult, and cer- nly we shall not return to the act condition from which we de- rted when war came. We shall ve learned many things, and it is be hoped that we shall not forget em. It is of especial importance at, as we readapt ourselves to a w period of peace, we should eserve the essential features which de this country great. In par- ular, the opportunity for the lividual creator, for the industrial neer, for the inventer with ion and practicality should not lost; and the atmosphere of our lustrial life should be favorable his efforts in our behalf.

Vannevar Bush, 1943 Edison Medalist

We are now in a struggle with capable and resourceful enemy a highly technical modern war, d our enemy had a long head rt. The effort to hold our own in a hnical contest is not, and will not be, by any means a ecure, or a struggle in which the outcome can be dicted a priori and with full confidence. We have had mobilize our technical and scientific resources to the l, and we have had to do so with the confusion that is vitable when a great lumbering democracy suddenly ns to war. It has been necessary to regulate, to impose ntrols, and to operate with a secrecy that is foreign to usual open methods. It has not been necessary, wever, to suppress thought and initiative and the demo- tic functioning of scientific and technical groups de- ed to important phases of the technical aspects of the r effort. The results thus far have been good. We do need to feel today that we are under a serious disad- ntage because we started late, but we are still in an ense contest where every nerve must be stretched to ain important results, and we shall remain in this situa- n until the issue is decided.

Yet when the full tale is told, or the part of it is told ich properly can be released, I am convinced that it show one thing and that it will show this forcefully. e free untrammeled science and engineering of a democracy, when it once becomes directed toward an objective with full vigor, can outstrip the regimented efforts of any totalitarian state, provided there is anything approaching equality of resources on the two sides. I believe that it will come to be realized fully that our progress in manufacturing with enormous speed the weapons needed by our Armed Forces, in improving these weapons, in initiating new ones, and in keeping our civilian economy with its enormous technical complication still running effectively, has not been matched by the enemy, and that this has occurred in no small degree because our wartime effort was built upon the existing structure of freedom, with all that the word implies.

This must be preserved. As we turn again to the days of peace, it must be preserved in spite of the trends that flow from the greater interdependence of society, in spite of the trends that are inherent in the growing maturity of a nation, in spite of selfish interests of every sort. There must remain in the United States the opportunity for an Edison, the opportunity for any youth with initiative, resourcefulness, practicality, and vision, to create in his own name and by his own efforts new things that will tend to make this country vigorous and strong and safe.

The way in which this can be accomplished is not immediately apparent. The difficulty does not reside in the attitude of the people, for certainly there is an overwhelming majority that holds strongly to the conviction that freedom of individual opportunity must not be allowed to lapse, and that this involves genuine industrial opportunity for the individual, or the small group of individuals that join in a business effort. The difficulty arises from two facts. First, there are great sections of our industrial affairs that can be handled economically only by large industrial units. Second, the very complexity of modern life requires increased and centralized governmental activity, in order that the public interest may be fully protected and furthered by those measures of regulation and public works which government alone can perform adequately. The point is that, as a people, we have two parallel objectives; and we have been clumsy at times and allowed one to submerge the other.

In time of war concentration of effort and the imposition of rigid controls is essential for a fully co-ordinated all-out effort. The question is raised why, if this concentration is more effective for war, is it not also more effective for peace. One answer is the fact that the war concentration is effective primarily because it was constructed out of elements that became available and efficient under the relative freedom of peacetime conditions in a democracy, and there is no assurance that a brief effective concentration would remain so. Quite the contrary is what I believe the record of history will show. A more complete reply lies in the fact that we seek in the United States something beyond mere mechanical efficiency; we seek a society in which initiative and talent may have an outlet, and in which the individual may have opportunity to rise by his own efforts and contributions and not merely by the fixed operation of a system. We would be willing to sacrifice, if need be, some mechanical efficiency in the interests of individual freedom. My own conviction is that no sacrifice in the full effectiveness of the country is truly involved in the long run; and that, on the contrary, the elements which have rendered us strong in the past will render us still stronger in the future if we have sufficient intelligence and conviction to insist upon their preservation.

When peace returns, controls automatically will become relaxed. This is not enough. A negative slump back to a state of drifting, buffered by the trends that are inherent in technical progress, will not carry us on our appointed course as a nation. A positive and well-thought-out effort is needed if we are to combine the conditions of modern industry and modern government with that freedom within unitary organizations and within society as a whole which will allow the unusual individual to have a real chance of accomplishment and success. It can be done, if we have the steadfastness and conviction to insist that it be done. In this effort the great body of engineers and scientific men in the United States have an important part, for they are in a unique position to view and understand both sides of a matter which is primarily technical, economic, and organizational. If we are wise there will be, in the future, many Edisons in the United States. They may not shine with his peculiar brilliance, but they will add to the well-being of the nation a necessary element which can be added in no other way. Their opportunity must be preserved open before them.

Aircraft Transformers—Small and Light

O. KILTIE
ASSOCIATE AIEE

A three-phase 400-cycle 32-kva transformer measuring 5 by 9 by 12 inches and weighing 43 pounds is one example of the highly specialized types of transformers which have been designed to meet the needs of a-c applications on aircraft. Long life is deliberately sacrificed in order to gain small size and light weight, operating temperatures being as high as 225 degrees centigrade.

THE necessity for lightweight and small-size aircraft transformers is evident, since any reduction in space and weight will result in larger capacities for fuel and bomb loads. Various types of transformers have been developed recently, such as, three-phase to single-phase, single-phase to three-phase, two-phase to three-phase, three-phase to two-phase, combination a-c to d-c transformer–rectifier self-regulated units, miniature-instrument type, and a line of general-purpose aircraft units with kilovolt-ampere ratings ranging from 100 volt-amperes to 5 kilovolt-amperes, with weights ranging from 0.8 pound to 9.5 pounds and operating at ultimate temperatures of 225 degrees centigrade. Included are vibrator–inverter transformers, voltage stabilizers, and high-voltage and low-voltage booster ignition coils.

GENERAL FEATURES

The construction used on many of these designs features open core and coils and screw-type terminals. On those units intended for high-temperature operation the terminal boards are made of Mycalex, and all internal connections are joined with silver solder. For normal temperature design, cloth-base Textolite is employed in terminal-board construction.

In design, careful attention is given to locate the center of gravity as low as possible and as near the mounting surface as practicable. All units are also designed to withstand vibration tests specified by the United States Army and Navy.

Core materials have been selected to operate at high flux density but not to saturate. Laminations ten mils thick, which provide for reasonable losses and allow practical manufacturing, are chosen for 400-cycle designs.

The choice of insulating materials is most important to permit operation of aircraft units at high temperatures far above those in past practices, furthering the primary object of weight reduction. All insulation in the special high-temperature units, including winding spools, layer insulation, wrappers, and conductor-turn insulation, is glass cloth and glass fiber impregnated with a specially developed resin capable of operating at 225 degrees centigrade.

To prevent oxidation of the copper wire at elevated temperatures the wire is cadmium plated prior to application of the glass fibers.

Overloads for short periods are permitted, during which the temperature may exceed operating values. This means that $1\frac{1}{2}$ to 2 times normal loads can be tolerated for a few minutes with no damage to the transformers.

Life tests have been completed on a four-pound two-kilovolt-ampere unit which operated in excess of 1,000 hours at 225 degrees centigrade. The unit was exposed to 95 per cent relative humidity, while cool and not operating, for eight hours in each 24-hour cycle. At the end of the life test the efficiency and heating had not changed appreciably, and continued operation was satisfactory.

ALTITUDE PERFORMANCE

Load tests have been made at sea level on a two-kilovolt-ampere 400-cycle high-temperature transformer to determine the extent of heating at various altitudes. To produce the same heating at other altitudes as obtained at se

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O. Kiltie is designing engineer, transformer engineering division, General Electric Company, Fort Wayne, Ind.

el, the load was then changed. The transformer is nost always mounted on a Dural plate or channel in the craft structure which will dissipate considerable heat. comparison was made on transformer heating by making d test with the test unit mounted on a 12-inch-square ral plate $^3/_{32}$-inch thick. The unit was then freely susnded in air to omit the plate. Heating data are shown Table I.

Test data in Table II show that the core dissipates most of the total losses as indicated by constant core temperature and the reduction in coil temperature with reduced loads. It may be observed that for constant ambient temperature the allowable output at 40,000 feet is 79 per cent of normal sea-level capacity. However, since the lower ambient temperatures encountered at high altitudes will compensate for additional heating, it is safe to operate the transformer at full capacity at all times.

ble I. Heating Data for Various Altitudes With and Without Dural Plate

titude	Load in Watts	With Dural Mounting Plate	Ambient Temperature (Deg C)	Ultimate Temperature (Deg C)		
				Outer Coil	Inner Coil	Top of Core
level	2,000	Yes	30	172	208	172
level	2,000	No	30	188	245	212
000 feet	2,000	Yes	30	181	217	186
000 feet	2,000	No	30	202	262	227
000 feet	2,000	Yes	30	193	229	199
000 feet	2,000	No	30	218	281	244
000 feet	2,000	Yes	30	206	242	208
000 feet	2,000	No	30	233	296	259

ble II. Output Loads at Various Altitudes for Same Core Temperatures

titude	Load in Watts	Ambient Temperature (Deg C)	Ultimate Temperature (Deg C)	
			Outer Coil	Top of Core
level	2,000	30	172	174
000 feet	1,830	30	156	174
000 feet	1,680	30	148	170
000 feet	1,570	30	144	170

ble III. Output Loads at Various Altitudes and Low Ambient Temperature

ltitude	Load in Watts	Ambient Temperature (Deg C)	Ultimate Temperature (Deg C)		
			Outer Coil	Inner Coil	Top of Core
level	2,000	−40	99	146	108
000 feet	2,000	−40	123	164	127
000 feet	2,000	−40	171	214	171

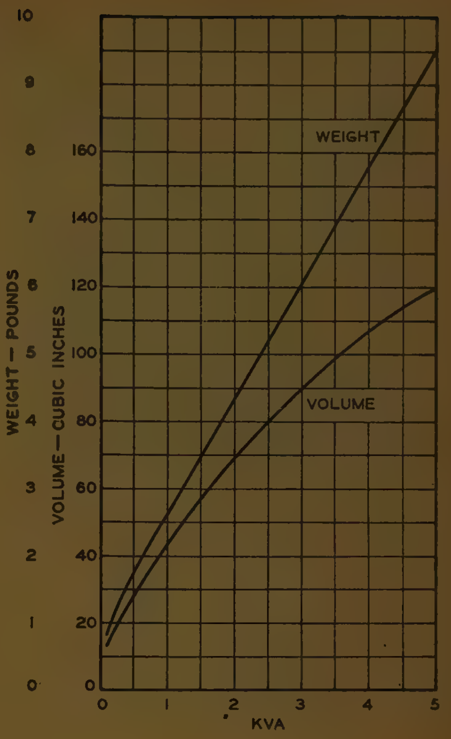
ble IV. Effects of Air Blast on Kilovolt-Ampere Rating at Various Altitudes

ltitude	Static Pressure Inches of Water	Load in Watts	Ultimate Temperature (Deg C) of Inner Coil
000 feet	0.27	2,000	117
000 feet	0.14	2,000	153
000 feet	0.27	2,670	212
000 feet	0.14	2,300	214

Table V. Electrical Data

Rating in lovolt-Amperes	Excitation Current in Per Cent of Full-Load Current	Voltage Regulation (Per Cent)	Efficiency (Per Cent)
0.100	42	13	87
0.250	35	11	90
0.500	26	10	91
1.000	10	7	92
2.000	7	6	93
5.000	6	5	94
32.500	5	4	95

Figure 1. Weight and volume characteristic of high-temperature aircraft transformer



Test data given in Table III show comparative temperature rises of core and coils over an ambient temperature of minus 40 degrees centigrade. By comparing these data with the data from Table I (with Dural mounting plate) it may be observed that cold ambient temperatures are not so effective as warmer ambient temperatures on heat dissipation at the higher altitudes.

The effects of an air blast on heat dissipation are observed in Table IV. A velocity of air, measured to be 3,380 feet per minute, was forced over the unit for the purpose of obtaining

1. The decrease in heating at rated load of 2,000 watts.
2. The allowable increase in load to obtain the same heating as is encountered at sea level with no forced ventilation and with use of the Dural plate.

Regulation, efficiency, and exciting current data are given in Table V.

STANDARD LINE FOR GENERAL PURPOSES

A standard line of single-phase high-temperature lightweight transformers for general-purpose aircraft applications has been established. The kilovolt-ampere ratings are: 0.100, 0.250, 0.500, 1.000, 2.000, and 5.000. The voltage ratings are 120 volts high voltage and 28.5 volts low voltage. Frequencies of 380 cycles minimum to 420 cycles maximum are standard, although use of higher frequencies is not objectionable. An operating temperature rise of 200 degrees centigrade is normal and makes possible large reductions in size and weight when comparison is made with transformers constructed with conventional materials.

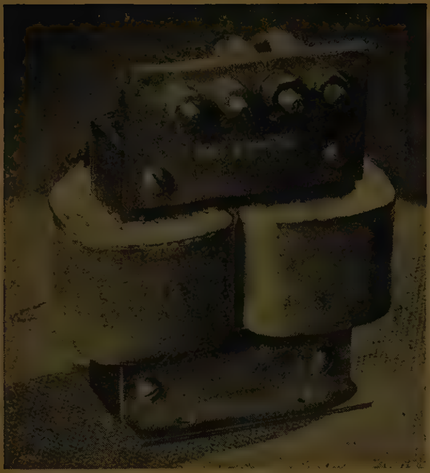


Figure 2. High-temperature aircraft transformer rated 400 cycles, 2.0 kva, 120 to 28.5 volts

Dimensions $2^{3}/_{8}$ by $4^{1}/_{4}$ by $4^{5}/_{8}$ inches

Weights and volumes are shown in Figure 1. Construction and appearance may be observed from Figure 2.

When mounting locations for these transformers are selected, consideration should be given to the high temperature at which they operate.

THREE-PHASE TRANSFORMERS

The special high-temperature materials used in the single-phase units just described are also adaptable to the construction of three-phase 400-cycle units. For example, a 32-kva three-phase unit was made with dimensions of 5 by 9 by 12 inches and weighing only 43 pounds. A 7.5-kva three-phase unit was made with dimensions of $2^{3}/_{4}$ by 7 by 7 inches and weighing only 13 pounds. Three-phase units will weigh approximately 20 per cent more than single-phase units for the same kilovolt-ampere rating.

TRANSFORMER–RECTIFIER UNITS

Developmental work is well advanced on two self-regulated transformer–rectifier units to operate directly from an engine-driven a-c generator; these units are rated at 100 and 200 amperes, respectively, at 30 volts, d-c output. The input frequency and voltage may vary independently of each other. The d-c output voltage may be selected at any value between 26 and 30 volts and held constant, regardless of load-current variations from no load to full load. The circuit includes a control reactor, a three-phase high-temperature transformer, a voltage-sensitive variable resistor, and a selenium rectifier. Units rated at 3.0 kw and 6.0 kw will weigh approximately 30 pounds and 55 pounds, respectively.

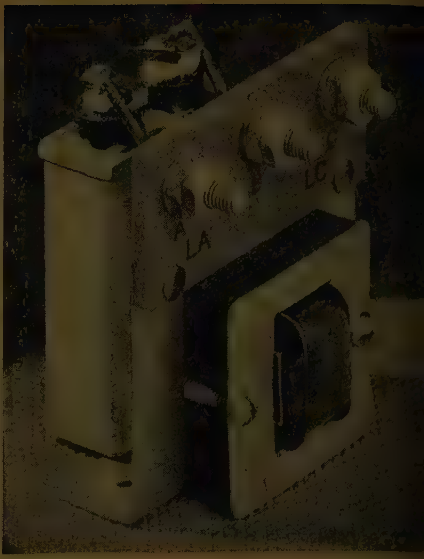
PHASE-CHANGING TRANSFORMERS

A definite trend toward increased use of single-phase electric equipment on aircraft has been noted. Many planes, particularly large bombers, have, as standar equipment, three-phase auxiliary generators, which, o course, are of limited capacity. A single-phase load connected to any one phase of the power supply would caus considerable unbalance in the three-phase voltages, which would also reduce the available volt-ampere capacity of th generator. Therefore, it became desirable to develop transformer to furnish a single-phase voltage which coul reflect balanced watts at equal power factors in the thre generator phases. Several designs have been complete in various ratings. Their efficiency is 90 per cent, an they operate at unity input power factor. Load variations do reflect in some unbalanced input power factor but the output voltage regulation is not seriously affected It is essential that phase rotation always be maintained i the stipulated direction and that the frequency remai constant. One such unit has been produced which wil deliver 115 watts at 115 volts and 400 cycles from a three phase 1,000-volt-ampere generator for the operation of single-phase radio compass of an automatic pilot. Thi unit weighs 2.38 pounds and has dimensions of $2^{1}/_{8}$ b $3^{7}/_{8}$ by $5^{1}/_{2}$ inches. Refer to Figure 3 for a constructio view.

For operation of small gyro instruments three-phas motors have been found most suitable. This makes i necessary on such aircraft as fighters, which are equippe with single-phase generators, to use single-phase to three phase transformers for operation of these instruments. A transformer using a special nonlinear split-phase circuit i now available which will supply 115 volts, three-phase, a 400 cycles from a 115-volt single-phase generator supply This supply will operate two *KB-1* or *KC-1* General Electric gyro instruments having a total load of 48 volt

Figure 4. Single-phase to three-phase transformer rated 400 cycles, 48 volt-amperes, 115 volts single phase to 115 volts three phase

Dimensions $2^{1}/_{16}$ by $2^{3}/_{8}$ by $2^{11}/_{16}$ inches



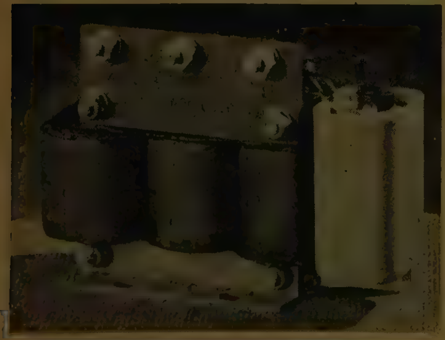
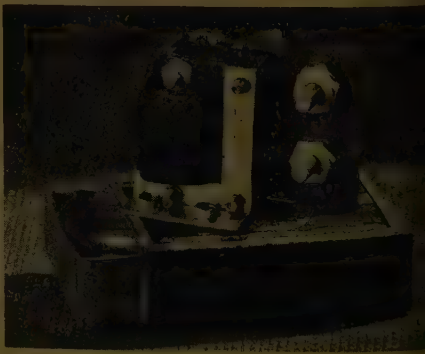


Figure 3. Three-phase to single-phase aircraft transformer rated 400 cycles, 0.115 kva, 115 volts three phase to 115 volts single phase

Dimensions 2 by $3^{3}/_{8}$ by $5^{1}/_{4}$ inches

Figure 5. Instrument autotransformer rated 400 cycles, 9.0 volt-amperes, 120 to 28.5 volts

Dimensions $1^{3}/_{8}$ by $1^{3}/_{8}$ by $1^{3}/_{4}$ inches



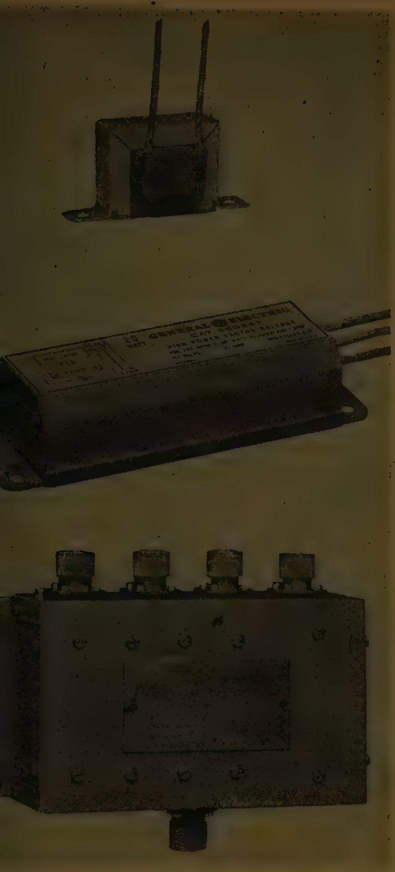


Figure 6. Reactor ballasts for fluorescent lighting on aircraft

eres. This transformer is so designed that it com-
ates for the difference in starting and operating load
er factors and thus permits rapid acceleration of the
motors; however in general, this type of transformer
ld be designed for specific loads in which the power
r and volt-amperes are essentially constant. The
sformer is both small and lightweight, weighing only
ounces. Refer to Figure 4 for a construction view.
here are other aircraft applications that require the
f two-phase to three-phase or three-phase to two-phase
sformers. Such units can be made small and light-
ht by use of special steels and insulating materials.

TRANSFORMERS FOR OTHER AIRCRAFT APPLICATIONS

nall single-phase transformers of 4.5- and 9.0-watt
gs are available for operation of other flight instru-
s such as the remote indicating compass. These units
h only two and three ounces, respectively, and are
minute in physical size. Refer to Figure 5 for construction view.

Small linear a-c reactors, required for certain miniature instruments, have also been developed. One such unit, rated 74 volts, 0.03 ampere, 400 cycles, and designed for assembly within the instrument, has a volume of only $1^1/_4$ cubic inches and weighs but two ounces.

Reactor ballasts are available for fluorescent lighting in aircraft having a suitable a-c power system. They serve the same purpose as in commercial practice, except that they are designed for light weight and small size and 400 cycles. Refer to Figure 6 for typical units.

VOLTAGE-STABILIZER TRANSFORMER

A recent development in voltage stabilizer for 60-cycle service is equally adaptable for 400-cycle or even 800-cycle aircraft systems. These units are used for those instruments which require a constant regulated input voltage. If the frequency is constant, the load, power factor, and input voltage may vary over wide limits; if the load and its power factor are constant, the input line voltage may vary; the frequency may also vary over a ten per cent range and yet provide for a constant output voltage held to within approximately three per cent.

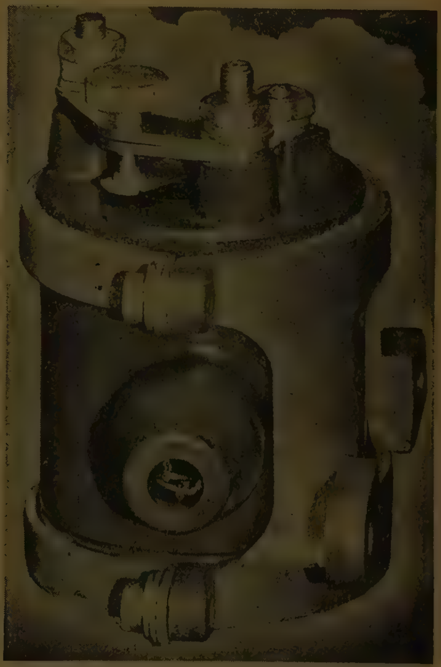


Figure 7A (left). Low-voltage ignition booster coil

Figure 7B (right). High-voltage ignition booster coil

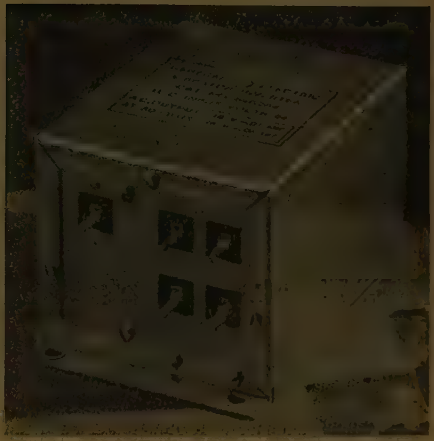


Figure 8. Vibrator-type inverter–transformer rated 24 volts direct current to 16-16 volts alternating current at 60 cycles with radio interference suppressed

BOOSTER IGNITION COILS

In the past it was common practice to use high-voltage ignition booster coils for providing positive ignition in starting aircraft engines. Recently, low-voltage booster coils have been made available, which operate directly from the battery and furnish rated current through the low-voltage winding of the magneto.

This low-voltage current is then stepped up by transformer action within the magneto to provide a high-voltage output suitable for ignition starting purposes. This system is being used extensively and is more practical in that it simplifies wiring and reduces radio interference. Refer to Figures 7A and B for typical units.

INVERTER TRANSFORMERS

Inverter transformers are available for those applications requiring a conversion of power from direct to alternating current or requiring a d-c voltage change. The frequency of the vibrator, which is an essential part of the equipment, is limited to a preferred 120 cycles. This prevents the adoption of inverter transformers, generally, to 400-cycle systems. They are now used extensively to provide a-c voltage to a special field winding of power-turret Amplidyne generators for controlling voltage fluctuations caused by residual flux. Without such control the turret will become unstable, and thus its accuracy will be reduced. A small two-pound inverter transformer operating directly from the battery will provide the necessary control. Refer to Figure 8 for a typical unit.

Inverters can be made to operate directly from th variable battery voltage to provide a self-regulated a- or d-c output voltage held constant within approximatel three per cent. Wave form is almost equivalent to sin wave and entirely suitable for most applications.

A circuit[1] is usually employed in which the vibrato contacts do not break current. This provides for lon reliable life of the equipment. Improvements have bee made recently to correct the output wave form, increas the efficiency, and provide stabilized output voltage.

CONCLUSIONS

The transformers discussed in this article are those whic seem most needed for aircraft applications. In man cases they have replaced heavy equipment and also hav made it possible for certain generators to serve dual purposes.

There may be many other applications which have no been mentioned; however, it is hoped that the information disclosed herein may be of value in solving transforme problems in the aircraft industry.

REFERENCE

1. New Type of D-C to A-C Vibrator Inverter, O. Kiltie. AIEE *Transactions*, volum 59, 1940, April section, pages 245–7.

United States dive bomber over Wake Island

Official United States Navy phot

Simple Method for Locating Ground Faults

JOHN I. HOLBECK
MEMBER AIEE

This article presents a simple, convenient, and inexpensive plan for determining the approximate location of ground faults on long transmission lines. Methods in use for locating all types of transmission-line faults are discussed briefly, but the main object is a discussion of line-to-ground faults, which occur far more frequently than phase-to-phase faults.

HEN A FAULT occurs on a long transmission line it is highly desirable to be able to determine quickly location of the fault so that valuable time may be ed in restoring the line to service. Use is made of ious devices for this purpose.

irectional Distance Relays. For a tie line protected h directional distance relays of the three-zone type, e idea of the approximate location of a phase-to-se fault can be obtained by observing the relay targets the two ends of the lted line. For example, e first-zone targets oper- at station *A* and the ond-zone targets operate tation *B*, it is logical to me that the fault is lo-ed in the end zone near ion *A*; that is, some-ere within the ten per t of the line length rest station *A*. On the er hand, should the first-e targets operate at sta- *B* and the second zone targets at station *A*, one ld conclude that the fault is in the end zone near- station *B*. If the first-zone targets operate at both s of the line, it is evident that the short circuit is lo-ed within the 80 per cent of the line length between two end zones. In other words, in this latter case, a 100-mile line the short circuit would be at least miles out from either station, and as much as 80 s of line might have to be patrolled between the two zones.

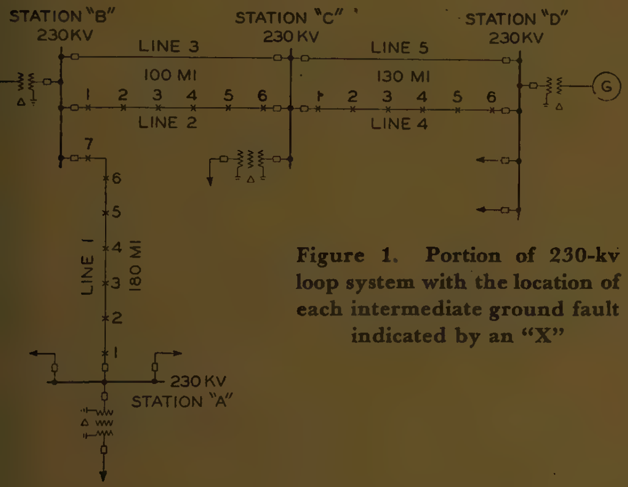


Figure 1. Portion of 230-kv loop system with the location of each intermediate ground fault indicated by an "X"

utomatic Oscillographs. From the foregoing discus- it can be seen that while the distance relay targets ot furnish much information as to the location of a fault, they do give some indication that is helpful to the trouble shooters. To get a closer approximation of the fault locations it would be necessary to install an automatic oscillograph at each end of a line to operate only during fault conditions. The oscillographs could be connected to record the bus voltages and the current in the three phases. However, it should be remembered that automatic oscillographs are rather expensive and, also, are hard to get under present war conditions.

High-Speed Graphic Meters. High-speed graphic meters are used to advantage on power systems with relatively slow relaying. For such a meter the pen pressure must be adjusted carefully to prevent bouncing when the meter goes into high speed, and the pen and inkwell must be cleaned at frequent regular intervals. This type of meter is too slow for a power system with fast relaying.

Electronic Devices. According to the March 1943 issue of *Electronics*,[1] some power systems now use carrier remote control to aid in locating quickly the faulty section of line when line failure occurs. This method requires the construction of carrier-controlled switching stations along the lines. Switching is thereby speeded up, as it becomes only a matter of dialing a number from the supervisory desk to open or close a remote switch. In this way, it is possible to determine quickly the approximate location of the line fault and to drop out that section of line.

Another electronics application for locating line faults is the use of a new device consisting essentially of a variable-frequency oscillator which feeds radio-frequency power into the line under test. The current fed into the transmission line is measured by a meter in the oscillator circuit.[1]

Disturbance Recorders. A disturbance recorder has been developed by Lloyd F. Hunt of the Southern California Edison Company and is described in the AIEE *Transactions*.[3] In some respects it is similar in operation to high-speed graphic meters on the market except that the pen is replaced with a spark gap.

Annunciator-Type Ammeters. Simple inexpensive annunciator-type ammeters can be applied with reasonable satisfaction for registering the magnitudes of fault currents. This type of ammeter consists of a number of target coils wound to operate in various current steps. Ammeters with six target coils are used on the Bonneville Power Administration system. The current value is printed on each target so that an operation will bring the printed

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John I. Holbeck is employed in the system engineering section of the Bonneville Power Administration, Portland, Oreg.

Table I. Line-Fault Data for Line 1

Fault Location in Miles from Station A	Maximum Ground Current in Amperes: From Station A, Primary	From Station A, Secondary*	From Station B, Primary	From Station B, Secondary*	Total Ground Current	From Station A With Line Open at B, Primary	From Station A With Line Open at B, Secondary*	From Station B With Line Open at A, Primary	From Station B With Line Open at A, Secondary*	Station to Clear Fir
Near station *A*	3,040	30.4	260	2.6	3,300	2,780	27.8	490	4.9	*A*
30	1,620	16.2	465	4.6	2,085	1,505	15.0	565	5.6	Simultaneou
60	1,075	10.7	640	6.4	1,715	1,055	10.5	690	6.9	Simultaneou
90	815	8.1	865	8.6	1,680	805	8.0	890	8.9	Simultaneou
120	605	6.0	1,205	12.0	1,810	640	6.4	1,195	11.9	Simultaneou
150	450	4.5	1,930	19.3	2,380	525	5.2	1,925	19.2	Simultaneou
Near station *B*	175	1.7	4,895	48.9	5,070	450	4.5	4,520	45.2	*B*

* Assumed current-transformer ratio of 500 to 5 amperes.

figure into view. Calibration of the targets may be in terms of either primary or secondary amperes. For purposes of this article we shall consider an annunciator-type ammeter with targets calibrated for 1, 3, 5, 10, 15, and 20 secondary amperes for the two ends of line 1 in Figure 1. If targets 1, 3, and 5 are up, it is known that the secondary current is more than five amperes but less than ten amperes. Similarly, if five of the six targets are up, the current is between 15 and 20 secondary amperes.

APPLICATION OF ANNUNCIATOR-TYPE AMMETER FOR LOCATING GROUND FAULTS

First of all, a ground-fault study must be made of the line under consideration. For example, let us consider a simple case; that of a 180-mile 230-kv transmission line connecting two stations *A* and *B* and labeled as line 1 in Figure 1. Fault currents are determined for intermediate points on the line in addition to those for the two ends by the use of a short-circuit calculating board. In this case, a ground fault is considered at each end of the line and also at five intermediate points. The current flow to the ground fault must be calculated with both ends of the line closed and also with one end open. These fault currents, shown in Table I, were determined on the calculating board by members of the Bonneville staff.

LOCATION OF FAULTS ON LINE 1

Table I shows the location of the fault, the total ground current and the input from each end before either end of the line clears by relay, the input to the fault from station *B* with the breaker open at station *A*, and th current flow from station *A* to the fault with the lir open at station *B*. An examination of the table show that, for this particular case, after one end of the fault line opens, the current flow from the opposite end ir creases. This must be taken into account in analyzin the meter readings following the clearing of a groun fault. All fault-current values are maximum rms value as no allowance has been made for any resistance at th point of fault. Secondary currents have been calculate on the basis of 500/5-ampere current transformers. I addition to directional distance relays, each end of th line is protected with a directional time-delay overcu rent ground relay and an instantaneous nondirection overcurrent ground relay.

Table II shows a method for determining approximat fault ground currents. One might conclude that actu fault currents in all cases will be much smaller than th calculated values, because of contact resistance at th point of fault, but staged tests on a 230-kv circuit on th Bonneville system do not confirm this conclusion. It wa found that the measured values of fault current were onl four to five per cent smaller than our calculated value Of course, on lower-voltage circuits, the fault resistanc does have an appreciable effect on the magnitude of ground fault. At any rate, regardless of the magnitud of the fault currents, the percentage of the total fau current flowing from each end of the faulted line will no vary. However, in applying the annunciator ammete as fault locators, it should be noted that, whenever th

Table II. Determination of Line-Fault Location by Use of Annunciator Ammeters

Ammeter at Station A: Highest Target	Ammeter at Station A: Primary Amperes	Ammeter at Station B: Highest Target	Ammeter at Station B: Primary Amperes	Total* Calculated Ground Fault Current (Amperes)	Per Cent of Total From Station A (Calculated)	Per Cent of Total From Station B (Calculated)	Apparent Locatio of Fault in Mile From Section A
20	Above 2,000	3	Above 300 Below 500	3,300	92	8	Near station *A*
15	Above 1,500 Below 2,000	3(5?)	Above 300 Below 500	2,085–3,300	78–92	8–22	Up to 30
10	Above 1,000 Below 1,500	5	Above 500 Below 1,000	1,715–2,085	63–78	22–37	30 to 60
5	Above 500 Below 1,000	5	Above 500 Below 1,000	1,680–1,715	48–63	37–52	60 to 90
5	Above 500 Below 1,000	10	Above 500 Below 1,000	1,680–1,810	33–48	52–67	90 to 120
3 (5?)	Above 300 Below 500	15	Above 1,500 Below 2,000	1,810–2,380	19–33	68–81	120 to 150
3	Above 300 Below 500	20	Above 2,000	2,380–5,070	2–19	81–98	150 to 180
3	Above 300 Below 500	20	Above 2,000	5,070	2	98	180

* Ground current before any breakers open.

Ammeters show maximum residual current flow from each end of line from instant that fault occurs until it is cleared. Assume current transformer ratio of 500 to 5 ampe at each end of line.

ndary ground current is just a trifle above the rating
certain ammeter target, it is questionable whether
target will operate, and due allowance must be made
hat fact.

s an example, for a ground fault at mile 30, the calcu-
ns show a flow of 1,620 amperes from station *A* and
amperes from station *B*. The secondary current at
on *B* is equivalent to 4.6 amperes. The instantaneous
nd relay at station *A* can be set to operate as low
.5 amperes and the one at station *B* as low as four
eres without operating for a bus fault at the opposite
of the line. However, the resistance in the fault
f can decrease the relay current from station *B* below
amperes and prevent it from operating. Then sta-
A will clear first. If the resistance of the fault itself
nored, the secondary relay current at *B* will increase
.6 amperes after station *A* clears. In this case the
est target may be either the three-ampere target or
five-ampere target. In all probability, only the one-
three-ampere targets will show at station *B* after the
fault is cleared at both ends.

ith similar instantaneous ground relays and similar
kers at the two ends of the line, it is expected that

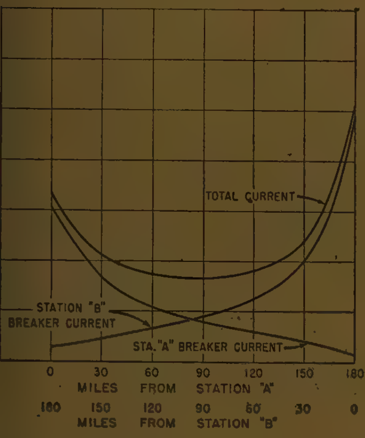

Figure 2. Ground currents for single phase - to - ground faults on line from station A to station B

: Three 230-kv generators on station B. Currents are plotted to show
tal maximum current flow to a ground fault at any intermediate point
e 1, and also the magnitude of the current flowing from each end of the line

ends of the line will clear simultaneously for low-
tance ground faults anywhere between mile 30 and
150. However, any slight difference in time delay
een relay and breaker at one end of the line as com-
d to the relay and breaker at the other end will
e one end to open first and to change the flow of
nd current. The ammeter targets, however, will be
cted by this change in current only for faults at the
end zones of the line, as indicated in Table I.

he per cent of total fault current from each end of the
at the instant a fault occurs is shown graphically in
re 3, while Figures 4 and 5 show the changes in
nd current after a breaker opens. For these calcu-
ns transient-reactance values have been used for all
rators and synchronous machines.

PARALLEL LINES 2, 3, 4, AND 5

milar fault-current readings have been made for
2 and 3 between stations *B* and *C*, and for lines 4
5 between stations *C* and *D*. These data are shown

Table III. Line-Fault Data for Line 2

Fault Location in Miles From Station B	Maximum Ground Current in Amperes							
	From Station B		From Station C		From Station B With Line Open at C		From Station C With Line Open at B	
	Primary	Secondary*	Primary	Secondary*	Primary	Secondary*	Primary	Secondary*
Near station *B*	5,225	52.2	160	1.6	5,235	52.3	855	8.5
20	2,500	25.0	585	5.8	2,580	25.8	980	9.8
40	1,565	15.6	855	8.5	1,775	17.7	1,150	11.5
60	1,100	11.0	1,150	11.5	1,385	13.8	1,385	13.8
80	765	7.6	1,590	15.9	1,100	11.0	1,785	17.8
Near station *C*	480	4.8	2,380	23.8	930	9.3	2,495	24.9

* Assumed current transformer ratio of 500 to 5 amperes.

Table IV. Line-Fault Data for Line 4

Fault Location in Miles From Station C	Maximum Ground Current in Amperes							
	From Station C		From Station D		From Station C With Line Open at D		From Station D With Line Open at C	
	Primary	Secondary*	Primary	Secondary*	Primary	Secondary*	Primary	Secondary*
Near station *B*	2,315	23.1	350	3.5	2,440	24.4	675	6.7
27	1,400	14.0	570	5.7	1,550	15.5	800	8.0
54	945	9.4	830	8.3	1,130	11.3	1,000	10.0
81	680	6.8	1,200	12.0	900	9.0	1,320	13.2
108	465	4.6	1,970	19.7	750	7.5	2,010	20.1
Near station *D*	110	1.1	4,305	43.0	650	6.5	4,190	41.9

* Assumed current transformer ratio of 500 to 5 amperes.

in Tables 3 and 4. In these cases, because of the effect of mutual induction between the parallel lines, the application becomes more difficult.

Incidentally, the parallel lines under discussion are protected with time-delay directional ground relays, nondirectional instantaneous ground relays, and high-speed current-balance ground relays. Both ends of a faulty line will clear almost simultaneously except for ground faults in the two end zones.

It will be noted that for a ground fault on line 2 near station *C*, the flow of ground current over the line from station *B* increases from 480 amperes to 930 amperes after the line opens at *B*. For line 4 the effect is even more pronounced, because, when the breaker at station *D* opens for a ground fault at that end of the line, the flow of ground current over the line from station *C* increases from a mere 110 to 650 amperes.

It is apparent that for lines 2 and 3 it would be advisable to install ammeter targets of a somewhat higher current range than for line 1. For example, for lines 2 and 3 at station *B* the targets could be wound for 3, 5, 10, 20, 30, and 40 secondary amperes. The targets for the other end of these two lines could be wound for 1, 3, 5, 10, 15, and 20 amperes. Space does not permit going into detail regarding the operation of the targets for the parallel lines but the application is somewhat similar to that outlined for line 1.

LOCATION OF ANNUNCIATOR AMMETERS

It has been assumed in this discussion that the annunciator ammeters are installed in the residual circuit of the line current transformers, but they can be installed also in the grounded neutral circuits of the power transformers at the stations. It would then be necessary to determine the per cent of the total ground current contributed by each bank for the various line faults.

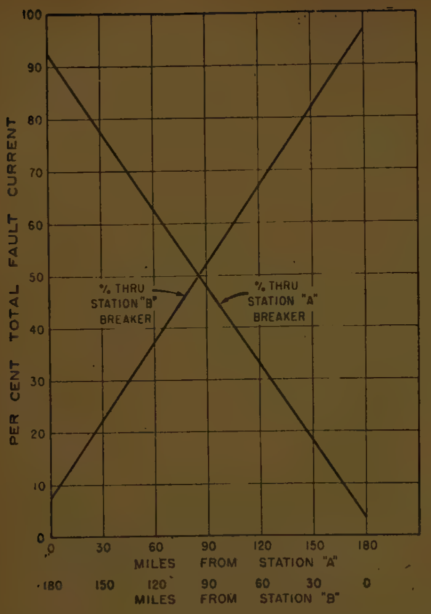

Figure 3. Per cent of total current from each end of the line for single phase-to-ground faults, and for intermediate points along the line

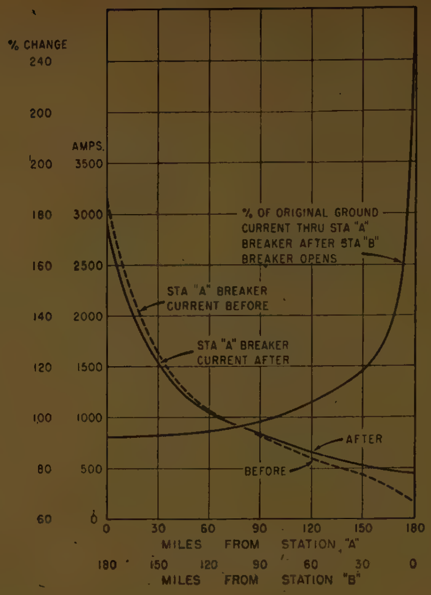

Figure 4. Change of current through station A line breaker after station B breaker opens, for single phase-to-ground faults

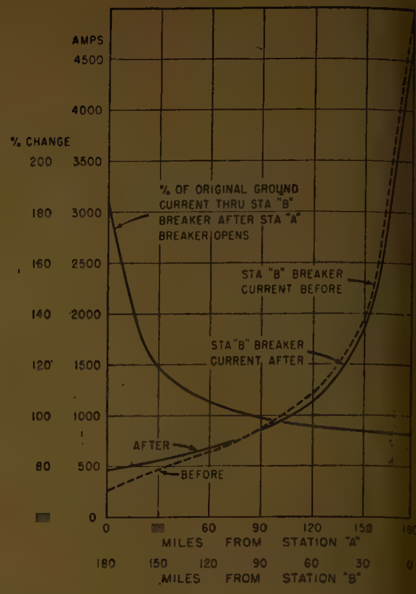

Figure 5. Change of current throug station B line breaker after station A breaker opens, for single phase-to- ground faults

OPERATING EXPERIENCE WITH ANNUNCIATOR AMMETERS

Fault calculations have been made for the power system of the Bonneville Power Administration, involving ground faults at intermediate points on the longer 230-kv lines for the purpose of applying annunciator-type ammeters to determine quickly the location of a line-to-ground fault after a tripout. The operating personnel reports very gratifying results. In fact, in one case they predicted the location of the fault within a mile or two.

CONCLUSIONS

When a fault occurs on a transmission line it is important to isolate, locate, and repair the fault quickly in order to keep service interruptions to a minimum. During present conditions it is more important than ever to keep the power flowing so that reductions in the output of war equipment can be prevented.

The shortage of man power and strategic war materials makes it necessary for the power systems to carry the added war loads with a minimum of new equipment, including all types of switchboard equipment. For these reasons use should be made of the simplest device which will do a given job with a reasonable degree of satisfaction.

In this article the discussion has centered around such an instrument—the annunciator ammeter. It is not the ideal device for helping to determine the location of ground faults, but it is inexpensive and easy to install an requires a minimum amount of material. It is of interes to note that annunciator ammeters also are being used t some extent on a power system in California for recordin the magnitudes of ground fault currents.

For a large power system it would be helpful to hav several portable oscillographs in addition to a number o annunciator ammeters. In the future, it is believed tha electronics devices will be in common use for the purpos of determining the location of line faults.

REFERENCES

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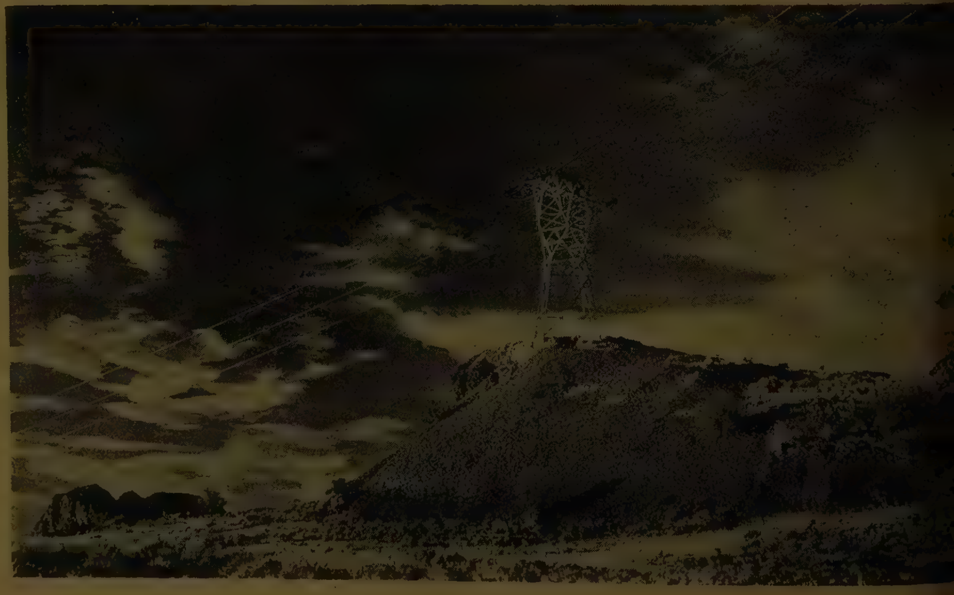
3. Some Practical Measuring Devices, **Lloyd F. Hunt.** AIEE *Transactions*, volum 59, 1940, pages 765–8.



NSTITUTE ACTIVITIES

orth Eastern District Technical Meeting to Be Held in Boston, Mass., April 19–20

two-day technical meeting of the AIEE h Eastern District will be held in Boston, ., Wednesday, April 19, and Thursday, l 20, 1944. Meeting headquarters will be at the Hotel Statler. The committees have arranged a broad program, which has been planned to help engineers engaged in promoting the war effort. Seven technical sessions will be held on the subjects of cables, transformers and selected subjects, electronics, power transmission, air transportation, electrical machinery, and industrial power applications. In addition, a student technical session will be held, at which papers will be presented by the students.

The 60th anniversary of the AIEE will be observed by a special session on Wednesday afternoon. In this session there will

Tentative Technical Program and Features

sday, April 18

rnoon Registration

p.m. Technical-Paper Competition for Younger Engineers

Statler, Salle Moderne. **R. W. Adams**, presiding

ectional prize competition, sponsored by Schenec- Lynn, and Pittsfield Sections

dnesday, April 19

a.m. Registration

0 a.m. Cables

. **Davis**, presiding

-FREQUENCY CABLE DESIGN AND TESTING. **N. D. ey, P. W. Ware**, Simplex Wire and Cable Com-

. CURRENT RATING OF CABLES AS AFFECTED BY JAL HEATING IN AIR OR CONDUIT. Insulated r Cable Engineers Association committee on re-

TIONAL EXPERIENCE WITH GAS-FILLED CABLES. . **Shanklin**, General Electric Company

HETIC INSULATION FOR CABLES. **C. A. Finkel**, The ite Company

TESTING AND FAULT LOCATION IN CABLES. **W. D. , L. A. Gray**, Simplex Wire and Cable Company

0 a.m. Transformers and Selected Subjects

Burke, presiding

LSE TESTING OF TRANSFORMERS. **J. H. Hagenguth**, ral Electric Company

N OF VARIAC TRANSFORMERS. **Edward Karplus**, ral Radio Company

ABILITY OF COMPRESSED-GAS INSULATION. **J. D. ne, E. C. Easton**, Harvard University

COOLED DRY-TYPE REGULATORS. **L. G. Tubbs**, nghouse Electric and Manufacturing Company

ICATION AND DESCRIPTION OF AUTOMATIC CONTROL SWITCHING EQUIPMENT FOR CAPACITOR BANKS. **. Schroeder, W. C. Bloomquist**, General Electric pany

LER-TANK OIL CIRCUIT BREAKERS. **W. M. Leeds**, nghouse Electric and Manufacturing Company

0 a.m. Student Session

inalga, presiding

student papers to be presented. Titles and authors announced later.

p.m. AIEE 60th Anniversary Observance

ISTORY OF THE INSTITUTE

UTURE OF ELECTRICAL ENGINEERING AND THE UTE

HE FUTURE OF AERONAUTICS

- **PAMPHLET reproductions of authors' manuscripts of some of the papers listed in the program may be made available. Abstracts of these papers will appear in the April issue.**

- **PRICES and instructions for procuring advance copies will accompany the abstracts.**

6:00 p.m. Presidential Reception

6:30 p.m. Get-Together Dinner

Statler Hotel Imperial Ballroom. **William H. Timbie**, toastmaster

Presentation of District prizes for papers

Nationally known speaker to be announced

Thursday, April 20

9:30 a.m. Electronics

T. S. Gray, presiding

DEVELOPMENT OF EXCITRON-TYPE RECTIFIER. **H. Winograd**, Allis-Chalmers Manufacturing Company

IGNITRONS, THEIR DEVELOPMENT AND USES. **J. C. Cox**, Westinghouse Electric and Manufacturing Company

OPERATION OF RECTIFIERS UNDER UNBALANCED CONDITIONS. **M. M. Morack**, General Electric Company

A GRAPHICAL ANALYSIS OF THE VOLTAGE AND CURRENT WAVE FORMS OF CONTROLLED-RECTIFIER CIRCUITS. **P. T. Chin, E. E. Moyer**, General Electric Company

ELECTRONIC CONTROL FOR D-C MOTORS. **B. J. Dalton**, General Electric Company

BROAD-BAND CARRIER SYSTEM FOR TELEPHONE CABLES. **J. P. Thurber**, New England Telephone and Telegraph Company

9:30 a.m. Power Transmission

C. A. Corney, presiding

110-KV TIE-LINE USES PROGRESSIVE DESIGN. **E. A. Church, E. G. Stebbins**, Boston Edison Company

IMPROVING THE PERFORMANCE OF 110-KV TRANSMISSION CIRCUITS. **D. H. Hathaway, A. B. Jones**, Boston Edison Company

CONVERSION OF MONTAUP ELECTRIC SYSTEM FROM 66-KV TO 110-KV. **W. B. Carnie**, Montaup Electric Company

MEASURED ELECTRICAL CONSTANTS 270-MILE 154-KV LINE. **C. A. Streifus**, Ebasco Service, Inc.; **C. S. Roadhouse**, Nebraska Power Company; **R. B. Gow**, Kansas Gas and Electric Company

2:00 p.m. Air Transportation

R. W. Adams, presiding

A-C AND D-C SHORT-CIRCUIT TESTS ON AIRCRAFT CABLES. **J. C. Cunningham, W. M. Davidson**, Westinghouse Electric and Manufacturing Company

ELECTRICALLY DRIVEN GYROSCOPES FOR AIRCRAFT. **H. M. Witherow, Albert Hansen, Jr.**, General Electric Company

DAMPING CYLINDERS FOR AIRCRAFT GYROSCOPES. **F. R. Sias, J. H. Wright**, General Electric Company

A UNIT FOR BALANCING THE VOLTAGES OF THREE-PHASE AIRCRAFT INVERTERS SUPPLYING LARGE SINGLE-PHASE LOADS. **Sydney Wimpie**, The Holtzer-Cabot Electric Company

BLAST-TUBE COOLING FOR AIRCRAFT GENERATORS. **C. G. Veinott**, Westinghouse Electric and Manufacturing Company

AIDS TO QUALITY CONTROL IN THE MANUFACTURE OF AIRCRAFT GENERATORS. **F. M. Potter**, General Electric Company

DIFFERENTIAL GENERATOR CONTROL RELAYS FOR D-C AIRCRAFT ELECTRICAL SYSTEMS. **F. E. Crever**, General Electric Company

2:00 p.m. Electrical Machinery

H. B. Ashenden, presiding

PREVENTION OF ROTOR-WINDING DEFORMATION ON TURBOGENERATORS. **J. G. Noest**, Consolidated Edison Company of New York, Inc.

VIBRATION PROTECTION FOR ROTATING MACHINERY. **R. L. Webb, C. S. Murray**, Consolidated Edison Company of New York, Inc.

EXCITERS FOR 3,600-RPM GENERATORS. **Clarence Lynn**, Westinghouse Electric and Manufacturing Company

BEHAVIOR FACTORS OF RECTIFIER-DRIVEN D-C MOTORS. **Victor Siegfried**, Worcester Polytechnic Institute

INTERPRETATIONS OF CURRENT–TIME CURVES AS APPLIED TO INSULATION TESTING. **R. F. Field**, General Radio Company

2:00 p.m. Industrial Power Applications

F. S. Bacon, Jr., presiding

VOLTAGE REGULATION IN INDUSTRIAL PLANTS. **Hugh McCrea**, General Electric Company

CAPACITORS IN INDUSTRIAL PLANTS. **J. E. Barkle**, Westinghouse Electric and Manufacturing Company

POWER SUPPLY FOR RESISTANCE WELDERS. **R. L. Briggs**, Thomson-Gibb Electric Welding Company

ELECTRONIC CONTROL FOR VARIABLE-SPEED MOTORS. **W. I. Bendz**, Westinghouse Electric and Manufacturing Company

SPEED CONTROL OF A-C MOTORS. **F. B. Haeussler**, General Electric Company

MAINTENANCE OF INDUSTRIAL MOTORS AND CONTROL. **H. E. Thomas**, Westinghouse Electric and Manufacturing Company

ELECTRONIC HEATING. **H. M. Chatto**, General Electric Company

This shell on the Esplanade along the Charles River just above Longfellow Bridge is the scene of outdoor concerts in Boston, Mass., in which city the North Eastern District technical meeting will be held April 19–20, 1944

be addresses on the history of the Institute, the future of electrical engineering and the Institute, and the future of aeronautics. On Wednesday evening a presidential reception will be followed by a get-together dinner. W. H. Timbie, Massachusetts Institute of Technology, Cambridge, will act as toastmaster, and the meeting will be addressed by a prominent speaker.

REGISTRATION

Members of the District and others who receive a mailed announcement of the meeting should fill in and return registration cards immediately upon receipt. Members from neighboring AIEE Districts will be most welcome. A registration fee of two dollars will be charged all nonmembers except Enrolled Students and the immediate families of members.

COMMITTEE

The general committee making the arrangements is headed by the following:

T. Cooper, Jr., *general chairman;* R. G. Porter, *vice-chairman;* J. M. Murray, *secretary–treasurer;* C. L. Dawes, *chairman, technical program;* J. G. Patterson, *secretary, technical program;* D. C. Jackson, *60th anniversary;* A. L. O'Banion, *hotel and registration;* F. S. Bacon, *dinner;* R. G. Porter, *student activities;* F. W. Bliss, *publicity.*

Well-Rounded Winter Meeting

Best Attended Since 1941

Boasting a total registration of 1,658 members and guests, the 1944 AIEE winter technical meeting, held January 24–28 in New York, N. Y., was the best attended since the 1941 winter meeting held in Philadelphia, Pa., when 1,931 were registered. The absence of bad weather during the meeting—for the first time in several years—may have been a cause of the increased registration. All technical sessions and conferences of the well-rounded program were exceptionally well attended, in many instances taxing the capacity of the meeting rooms in the Engineering Societies Building. As in previous wartime meetings, first attention was devoted to problems related either directly or indirectly to the war effort.

The final meeting program deviated from the tentative program published in the January issue in several respects. There were no conferences on welding, marine transportation, or automatic stations. The special lecture and inspection trip at the Brooklyn Navy Yard for specially selected and invited teaching personnel scheduled for Saturday morning was divided into two parts: the
lecture, on "Power Aspects of the Electr
Circuit and Electric-Machinery Courses
the Navy *V*-12 Program," which was give
Friday morning at the Engineering Societi
Building; and the inspection trip throug
the Navy Yard which was taken Thursda
afternoon.

Among important official actions taken
the meeting was the authorization by th
AIEE board of directors of a committee
study conditions affecting the security
employment and compensation among ele
trical engineers, with special reference
the problem of collective bargaining. D
tails are given in a separate item.

TECHNICAL SESSIONS AND CONFERENCE

Topping the list of technical sessions an
conferences related directly to the war we
two sessions on electrical applications to a
transportation and two conferences devote
to a discussion of problems associated wit
the military specialized training program
One conference was devoted primarily t
electrical problems of war industries. I
addition, many of the papers presented a
the sessions on power generation, transmi
sion and distribution, electrical machiner
protective devices, electrical measurement
land transportation, and communicatio
were related to problems imposed by wartim
conditions.

Brief reports of the conferences are give
in succeeding pages. With the exception
the few instances where session chairme
furnished accounts of the technical session
however, the sessions are not reported her
as all approved papers and discussions will b
published in the *Transactions.*

GENERAL SESSION

A departure from the custom of presentin
the Edison Medal at an evening session, th
presentation ceremonies this year took plac
during the first half of the general sessio
Wednesday morning, January 26. As pre
viously announced, the medal was presente
to Vannevar Bush, president of the Carnegi
Institution of Washington (D. C.), and direc
tor of the Office of Scientific Research an
Development. Past President Frank B
Jewett presented an outline of Doctor Bush'
career declaring that: "He is a great scien
tist and engineer; a great teacher and ad
ministrator, and a great American in
sense that no few words can encompass. T
me that greatness is the greatness of man
positive personal contributions and a host o
others which his leadership has inspired.
The history of the Edison Medal wa
sketched by Chairman W. B. Kouwenhove
of the Edison Medal committee and th
actual presentation was made by Presiden

Analysis of Registration at 1944 Winter Technical Meeting

Classification	Dist. 3	Dist. 1	Dist. 2	Dist. 4	Dist. 5	Dist. 6	Dist. 7	Dist. 8	Dist. 9	Dist. 10	Totals
Members	513	261	409	61	117	2	20	2	6	26	1,417
Men guests	83	28	54	13	13	1		2		3	197
Women guests	11	5	9	5	1						31
Enrolled students	1	7	2	1		1	1				13
Totals	608	301	474	80	131	4	21	4	6	29	1,658

Analysis of Registration at Recent Winte Technical Meetings

District	1941*	1942	1943	194
New York and foreign (3)	523	549	569	60
Middle Eastern (2)	946	349	417	47
North Eastern (1)	276	237	254	30
Great Lakes (5)	122	93	97	13
Southern (4)	27	68	22	8
Canada (10)	12	11	25	2
South West (7)	2	9	17	2
North West (9)	3	2	6	
North Central (6)	8	7	6	
Pacific (8)	12	6	6	
Totals	1,931	1,331	1,419	1,65

* Held in Philadelphia, Pa.; all others in New York.

n E. Funk, who presided throughout the
ral session. Essentially full text of Doc-
Jewett's address and Doctor Bush's re-
se appear elsewhere in this issue.

uring the second half of the general ses-
an address on the assigned topic of
e Engineer in America's Business Future"
delivered by Willard Chevalier, publisher
Business Week and vice-president of
Graw-Hill Publishing Company, Inc.,
York. Likening the struggle between
collectivists and the individualists that
n in the United States in the '30's to a
e of cards, he described the "high cards"
by the two contending factions and de-
d that the final outcome would be deter-
d by the people of the United States
he basis of events during the first few
s after the war. He recommended a
level of employment, a high level of
uction, and high-production efficiency
e tripartite basis of an expanding postwar
omy. The essential substance of Colonel
valier's address appears elsewhere in this
under the title: "A Postwar Economy
he United States."

OTHER FEATURES

nong other features of special interest at
neeting was an evening session sponsored
ly by AIEE and the Institute of Radio
neers which held its winter meeting in
York during the latter part of the week.

or General Roger B. Colton, chief,
neering and technical service, Signal
s, United States Army, delivered the
re address on "Enemy Army Com-
cations Equipment." Describing cap-
German, Italian, and Japanese military
nunication equipment, General Colton
red that: "American engineers have
instrumental in giving to the United
s Army and to the Signal Corps of the
the best equipment in the world."
er details are reported in a separate
Supplementing General Colton's
ss, an array of captured enemy equip-
and United States equipment was on
y during the latter half of the meeting
This exhibit, arranged by Bell Tele-
Laboratories, Inc., for the Signal
, aroused a great deal of interest not
among those who heard General
n's address, but also among others
ling the meeting.

mprising the final of four events spon-
during the week by the Institute's
ittee on education, another evening
featured an address, "Electricity on
oard," by Captain H. G. Rickover,
electrical section, Bureau of Ships,
d States Navy. This was of especial
st to those specially invited to earlier
ences on teaching problems associated
he Navy college training program.

plementing similar conferences held
previous national meetings, a con-
e was held this year on civic affairs and
ration with other organizations. The
ions centered largely around local co-
ive action between AIEE Sections and
local engineering groups.

ther details on the special features are
ed in separate items.

evening smoker constituted the only
led entertainment event of the meet-
A record total of 1,580 members and
jammed the grand ballroom of the
odore Hotel for this event, which
sed a dinner and entertainment.

Attendance at Sessions and Conferences of 1943 Winter Technical Meeting

	Technical Sessions		Conferences		Special Sessions	
	No.	Attendance	No.	Attendance	No.	Attendance
Monday a.m.	2	280				
Monday p.m.	2	325				
Tuesday a.m.	1	255	2	160		
Tuesday p.m.	2	335	2	200		
Wednesday a.m.					1	260
Wednesday p.m.	1	85	2	92	1	180
Thursday a.m.	1	200	2	165		
Thursday p.m.	3	477				
Thursday eve.					1	745
Friday a.m.	1	80			1	50
Friday p.m.	1	110	1	75		
Friday eve.					1	250
Totals	14	2,147	9	692	5	1,485
Average attendance		154		77		297

DIRECTORS AND COMMITTEES MEET

As usual during winter meeting week the AIEE board of directors and the national nominating committee met. The board meeting is reported elsewhere in this issue; the official nominees for 1944 election to national Institute offices selected at the meeting of the nominating committee were published in the February issue (*page 65*). Meetings of the following committees and subcommittees also were held:

Committees

AIEE Sections; land transportation; power generation; electrical machinery; Lamme Medal; membership; communication; safety; Standards; automatic stations; electronics; domestic and commercial applications; electrochemistry and electrometallurgy; Engineering Foundation–AIEE Research Project on Insulating Oils and Cable Saturants; electric welding; Student Branches; education; finance; publication; planning and co-ordination; power transmission and distribution; air transportation.

Subcommittees

Lightning arrester; insulation resistance; power-system applications of carrier current; protective devices chairmen; lightning and insulator working group; electrical hazards to farm animals; Standards co-ordinating committee 4; industrial control; industrial distribution systems guide; voltage transients in arc-furnace circuits; working group on fuses; stationary contact surfaces of standards co-ordinating committee 7; working group on Standard 20; relay; mercury-arc rectifiers; dry-plate rectifiers; transformer; nomenclature and graphical symbols; circuit-breaker standards.

Available reports of these committee meetings are included in separate items.

WINTER MEETING COMMITTEES

Chairman of the general committee for the 1944 winter technical meeting was J. F. Fairman; other members included W. J. Barrett, F. A. Cowan, J. L. Callahan, M. D. Hooven, C. R. Jones, R. A. Jones, F. V. Magalhaes, and C. S. Purnell.

The smoker committee consisted of W. R. VanSteenburgh, *chairman;* Carl Bolles, A. J. Cooper, T. C. Duncan, H. E. Farrer, J. B. Harris, Jr., C. T. Hatcher, William Jordan, E. G. D. Paterson, W. H. Rodgers, T. I. Rogers, H. B. Snow, T. W. Stauber, D. W. Taylor, and E. F. Thrall.

The committee responsible for arranging the joint AIEE–IRE session was comprised of: H. A. Affel, Austin Bailey, E. J. Content, F. B. Llewellyn, Lieutenant Colonel C. J. McIntyre, L. G. Pacent, and B. E. Shackelford.

Board of Directors Meets During Winter Technical Meeting

Appointment of a committee by the president to study conditions affecting security of employment and compensation among electrical engineers, with special reference to problems of collective bargaining was authorized by the AIEE board of directors at its regular meeting at Institute headquarters, New York, January 27, 1944 (for details see item elsewhere in this issue).

A resolution was adopted, in accordance with section 26 of the bylaws, setting the place and date of the 1944 annual meeting of the Institute at St. Louis, Mo., Monday, June 26. Chairman B. D. Hull of the 1944 AIEE summer technical meeting committee reported the plans of the committee for the meeting to be held in St. Louis, June 26–30. The plans were approved.

The committee on planning and co-ordination reported on certain suggestions which had been referred to it and its conclusions that these suggestions should not be adopted at the present time. Briefly, the suggestions were for the engagement by the Institute of a publicity expert, the establishment of a new office of vice-president to represent all foreign members and Sections (except Canada), and the establishment of a civic affairs committee. The board approved the recommendations of the committee on planning and co-ordination.

Upon request of the Districts concerned and recommendation of the committee on planning and co-ordination, District meetings were authorized as follows: North Eastern District meeting in Buffalo, N. Y., in the late spring of 1945—date to be determined by the executive committee of the District; Southern District meeting in the fall of 1945—date and place to be determined by the executive committee of that District.

A communication from The Institution of Engineers, Australia, was presented, conveying cordial and sincere greetings to the members of the AIEE and a warm invitation to those of them on service in Australia to avail themselves of the facilities of that Institution—meetings, publications, reference libraries. The board adopted a resolution expressing its appreciation of the invitation and thanks for the hospitality which has been extended to AIEE members and extending similar privileges to the members of The Institution of Engineers, Australia, serving in or passing through the United States.

Upon recommendation of the finance committee, a resolution was adopted continuing during the year beginning May 1, 1944, the provision for granting members in countries affected by abnormal exchange rates, in payments of membership dues and subscriptions and purchases of Institute publications amounting to two dollars or over, an exchange allowance corresponding to the difference between the New York exchange value and the normal par value of the payment, such allowance not to exceed 60 per cent of the bills payable.

T. H. Morgan and I. Melville Stein were reappointed the representatives of the Institute on the council of the American Association for the Advancement of Science for the year 1944.

Following the recommendations of the officers of the Section and the Sections committee, the board voted to remove the Midwestern Canada Section (formerly Saskatchewan Section) from the list of operating Sections of the Institute, in view of the inactivity of the Section due to unusual conditions.

Upon recommendation of the Sections committee, the vice-presidents of the South West District and the Southern District, and the Memphis, North Texas, and Tulsa Sections, the following actions were taken:

Unassigned territory in the State of Arkansas allocated and District and Section boundary lines adjacent to the area rearranged as follows:

The following 39 counties were assigned to the Memphis Section and transferred from District 7 (South West) to District 4 (Southern): Arkansas, Ashley, Bradley, Calhoun, Chicot, Clark, Clay, Clebourne, Cleveland, Conway, Dallas, Desha, Drew, Faulkner, Fulton, Garland, Grant, Greene, Hot Springs, Independence, Izard, Jackson, Jefferson, Lawrence, Lincoln, Lonoke, Monroe, Perry, Prarie, Pulaski, Quachita, Randolph, Saline Sharp, Stone, Union, Van Buren, White, Woodruff.

The following 13 counties were assigned to the Tulsa Section: Baxter, Boone, Carroll, Franklin, Johnson, Logan, Madison, Marion, Montgomery, Newton, Pope, Searcy, Yell.

The following six counties were assigned to the North Texas Section: Columbia, Hempsted, Lafayette, Miller, Nevada, Pike.

The following three counties were transferred from the territory of the Tulsa Section to that of the North Texas Section: Howard, Little River, Sevier.

A report was presented by the special committee appointed by action of the board of directors at its meeting on June 24, 1943, to study the use of dues paid by Members-for-Life, and the board adopted recommendations of the committee that the voluntary dues payments by Members-for-Life be kept in a separate fund in the custody of the treasurer of the Institute, such fund to be suitably designated to indicate its source; that the fund and its proceeds be used only for such special purpose or purposes as will aid the objectives of the Institute; that at least 25 per cent of each year's receipts be retained as an addition to the "capital" part of the fund for application to a nonrecurring project deemed suitable for financial support, the remainder of the yearly receipts being available for such annual recurring or other projects as may be established; and that a suitably designated standing committee be appointed which will have complete and sole administration of the fund and the particular purpose or purposes for which it may be used.

Other actions by the board, included the following:

Actions taken in accordance with recommendations of the Standards committee:

AIEE representatives appointed: L. C. Ilsley for a two-year term beginning January 1, 1944, on the American Standards Association Mining Standardization Correlating Committee (reappointment); D. K. Frost on ASA Sectional Committee *C*6, "Terminal Markings for Electric-Power Apparatus," (to replace R. S. Elberty, Jr.; appointment subject to acceptance of Mr. Frost's application for membership); M. S. Coover, E. H. Martindale, and Sidney Withington on ASA Sectional Committee *C*64, "Carbon, Graphite and Metal-Graphite Brushes"; A. B. Campbell as alternate representative on Sectional Committee *C*2, "National Electrical Safety Code"; Gilbert D. McCann, Jr., on Sectional Committee *C*5, "Code for Protection Against Lightning," (to replace A. M. Opsahl).

Approved the addition of a third sponsor, the National Fire Protection Association, for Sectional Committee *C*5, "Code for Protection Against Lightning," (the other two sponsors being the National Bureau of Standards and the AIEE).

Approved for immediate publication a revision, prepared by the committee on marine transportation, of the pamphlet 45*A* of April 1, 1943, "Modification of and Supplement to AIEE Standard 45—Recommended Practice for Electrical Installations on Shipboard."

Approved for publication as an AIEE Standard, a report, with certain approved revisions, prepared by the committee on protective devices, on "Capacitance Potential Devices and Outdoor Coupling Capacitors" (AIEE Standard 31), which was published in December 1941 as a proposed Standard for trial use.

Approved for submission to ASA with recommendation for approval as American Standards: Report of Sectional Committee *C*62, "Lightning Arresters," (AIEE Standard 28), and report of Sectional Committee *Z*32.10, "Graphical Symbols for Electronic Devices."

Actions of the executive committee reported and confirmed: As of November 24, 1943, five applicants transferred and one elected to the grade of Fellow; three applicants transferred and 19 elected to the grad of Member; 78 applicants elected to the grade of Associate; 241 Students enrolled. As of December 29, 1943, four applicants transferred and one elected to th grade of Fellow; 66 applicants transferred and 2 elected to the grade of Member; 134 applicants electe to the grade of Associate; 257 Students enrolled.

Reports were presented and approved of meetings o the board of examiners held November 18, and December 22, 1943, and January 20, 1944. Upon recommendation of the board of examiners, the followin actions were taken: five applicants were transferred t the grade of Fellow; 28 applicants were transferred an 34 were elected to the grade of Member; 146 applican were elected to the grade of Associate; one Associat was reinstated; 158 Students were enrolled.

Monthly disbursements were reported by the financ committee and approved as follows: Novembe $29,274.15; December, $29,519.05; January, $24,869.4

The board adopted a resolution expressin its appreciation of the arrangements mad by the technical program committee, th winter technical meeting committee, and th smoker committee for an outstanding program for the 1944 winter technical meetin of the Institute.

Those present were:

President—Nevin E. Funk, Philadelphia, Pa.

Past Presidents—H. S. Osborne, New York; D. C. Princ Schenectady, N. Y.

Vice-Presidents—A. G. Dewars, Minneapolis, Minn W. J. Gilson, Toronto, Ont.; C. R. Jones, New Yor E. T. Mahood, Kansas City, Mo.; K. B. McEachro Pittsfield, Mass.; C. W. Ricker, New Orleans, La E. W. Schilling, Bozeman, Mont.; W. E. Wickende Cleveland, Ohio.

Directors—T. F. Barton, New York; M. S. Coove Ames, Iowa; C. M. Laffoon, East Pittsburgh, Pa.; G. LeClair, Chicago, Ill.; F. R. Maxwell, Jr., Pensacol Fla.; C. W. Mier, Dallas, Tex.; S. H. Mortense Milwaukee, Wis.; W. B. Morton, Philadelphia, Pa W. R. Smith, Newark, N. J.; R. G. Warner, Ne Haven, Conn.

National Treasurer—W. I. Slichter, New York.

National Secretary—H. H. Henline, New York.

Conferences Held on Temperature Ratings o Continuous-Duty and Intermittent Machine

Two conferences on the measurement of permissible temperature rises on electrical machines were conducted at the 1944 AIEE winter technical meeting, January 25, in New York, N. Y. Seven informal papers were presented at the morning conference, devoted to measurement of temperature rise in continuous-duty machines. C. E. Kilbourne (M '37) chairman of the AIEE subcommittee on d-c machinery, presided. J. F. Calvert (M '35) vice-chairman of the AIEE committee on electrical machinery, conducted the afternoon session on permissible temperature rises of short-time rated machines.

CONTINUOUS-DUTY MACHINES

The purpose of this conference was to develop factual information through actual test reports which might be used in reaching conclusions concerning the adoption and revision of standards of permissible rise by resistance for all windings of continuous-duty machines. The present American Standard *C*–50, "Rotating Electrical Machinery," approved March 29, 1943, recognizes the resistance method of temperature determination only to the extent of establishing standards for shunt-field windings. Basic to a the discussions and reports was the Mem randum on Addendum to American Stan ard *C*–50, issued by the AIEE Standar co-ordinating committee 4, P. L. Alg (F '30) chairman.

Mr. Alger, addressing the group before t presentation of the papers, explained that t thermometer method had been establish as standard because, at the time, comple information was lacking as to the accura of resistance measurements. In view of t fact that railway motors are standardiz already on the resistance method, and th it is used broadly in Europe, the committ considered it necessary that proper limits f the resistance method be established whi can be used optionally by the manufactur The committee tentatively suggested lim of 65 and 100 degrees centigrade for clas and *B* insulated machines, respectively.

The conference papers evidenced co siderable divergence of opinion. So papers supported the greater accuracy of t rise by resistance measurements for dete mining internal temperature, whereas oth indicated that rises by thermometer thermocouple give better approximati

he hot-spot temperature of the ma-
e.

ne general opinion at the end of the con-
ice tended to the following conclusion: ited, that the rise by resistance method nperature measurement, performed with roper technique, was the more accurate; so, is an average value desirable in lishing permissible temperature ratings will protect the insulation life of the ma-
e? Should not efforts be made to deter-
a method which gives a result more ly related to the hot-spot or maximum, perature, since this temperature is the one causes deterioration and breakdown? he basis of the wide discrepancy in the s of rise by resistance to rise by ther-
eter found in the several papers pre-
d, it was generally agreed that further controversial tests would be necessary e any adoptions or revisions to standards l be made. A brief summary of each e papers follows.

establish the facts before the conference, . Compton, Jr. (A '39) General Electric pany, Erie, Pa., reviewed the pertinent lights of his paper, "Temperature Limits Measurements for Rating D-C Machines" *E Trans, Dec '43, pp 780–5*). According s experience, tests using resistance meas-
ents, with improvements in technique, disclosed different temperatures than indicated by thermometers. On the of this observation and the fact that er accuracy and consistency can be ved with the resistance method, he nmended that the rise-by-resistance od be used more generally, and that ately it should be recognized in the dards, as is now the case for railway rs.

the tests reported by L. E. Miller 36) Reliance Electric and Engineering pany, Cleveland, Ohio, conditions con-
cting those in Mr. Compton's paper presented. Mr. Miller took issue with Compton's conclusions on the basis that he results obtained were not general hat (2) the proper differential to be as-
d is still a debatable question. In the which Mr. Miller reported, the re-
d temperature rise of the armature by ance would have been from four to degrees less than the thermometers ed actually existed. However, Mr. r stated that his resistance measure-
s were taken five to ten minutes after own and were not corrected to the nt of shutdown as Mr. Compton's This may account for some difference, mitted.

. Miller further brought out that such s are not general but are particularly of d-c armatures operating with a high e of ventilation, since the heat dissipa-
in such cases, may be much greater in art of the armature than in another.

is believed," he said, "that the ratios nperature rise by resistance to tempera-
rise by thermometer depend more or n the type and design of machine. variations in design and manufacture, erage temperature cannot be substi-
for a rise in the hottest observable part one is willing to ignore the effect of rature on the insulation of that

seven recent tests of continuous, open, rial d-c motors, C. B. Hathaway) Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., reported that the average rise by the resistance method was 38 per cent higher than that measured by thermometers. On 63 tests of induction motors the average temperature rise by the resistance method was 29 per cent higher than that by thermometer for open machines and 18 per cent higher for closed machines. In neither test group did the results indicate any discernible relation between the differences in the two methods and the size and speed of the motors.

Shown at the winter technical meeting are A. H. Frampton, Hydro-Electric Power Commission of Ontario; J. B. MacNeill, chairman of the AIEE protective devices committee, who presided at the session on relays; and J. F. Fairman, chairman of the AIEE winter technical meeting committee

Mr. Hathaway's conclusions were as follows: "If it can be assumed that the temperatures as recorded by the thermometers are correct and that the resistance readings are accurate, then the variation of the difference obtained by the two methods derives from causes which we do not recognize. It has been the experience of our company that we are able to predict within a few degrees by thermometer the temperature rise of a new design. Therefore, until we develop our knowledge of temperature rises by resistance to the same point, we feel it unwise to embark on a general policy of making guarantees by this method."

T. E. M. Carville (M '32) Westinghouse Electric and Manufacturing Company, Lima, Ohio, confined his comments to fractional-horsepower motors. "Recent plant tests," he said, "have yielded a ratio of rise by resistance to rise by thermometer of 1.17 for single-phase motors and 1.22 for totally enclosed polyphase motors. If 60 degrees centigrade rise by resistance be adopted, the corresponding rise by thermometer should be 50 degrees centigrade to agree with these ratios. However, it is recommended that 55 degrees by thermometer reading be retained and the proposed 65 degrees centigrade by resistance measurements be allowed."

Mr. Carville also recommended that the proposed revision to the Standard, authorizing the optional use of the rise-by-resistance method, be amended to include recognition of the thermocouple method as applicable to fractional-horsepower motors. The values for the surface thermocouple method should be the same as the values by the resistance method, as was demonstrated by accompanying data. However, the standard for surface thermocouple measurements should be set up so that customers who insist that the thermocouple method be used will not expect the same limit as that set for the thermometer method. Comparison of tests on d-c and a-c machines showed the need for higher resistance values for d-c machines, a need consistent with past performance records.

A paper by H. L. Smith (F '42) Louis Allis Company, Milwaukee, Wis., who was unable to be present, was read by T. M. Linville (M '34) conference secretary. The results of the test data indicated that much more refined methods must be used for resistance measurements, as indicated by the wide variation in results, although they were found to be fair checks as to thermometer readings on different motors of the same design. The only general conclusion advanced was that present resistance measurements of the armature and interpole circuits are not accurate enough to be used independently, and that the more accurate shunt-field data would indicate a rise by resistance around 20 degrees centigrade higher than that by thermometer.

A paper presented by M. A. Baker (A '42) General Electric Company, Fort Wayne, Ind., included test data to support the co-ordinating committee's recommendation of higher limits, and showed how conservatively chosen the proposed values are. The existing and proposed ratios for rise by resistance to rise by thermometer, and the maximum, mean, and minimum test ratios were given in a pair of tables. The tabulations, interpreted graphically, showed plainly that the users of d-c machines are dependent upon the manufacturers to avoid unsatisfactory temperatures and that the thermometer test is variable.

R. H. Norris presented a paper prepared jointly by himself and F. Burggraf, both from General Electric Company, Schenectady, N. Y. Charts were exhibited showing it is an error to reason that thermometers placed on the rotor windings of d-c machines giving maximum readings four to five minutes after application show anything more than the temperature of the core iron. Actually the iron temperature is 50 to 70 per cent of the mean copper temperature at the instant of shutdown. A cooling curve was exhibited showing that initially the copper in the core portion cools to iron temperature, and this is followed by cooling of the end windings to iron temperature, and finally by cooling of the rotor mass by free convection. For an accurate test using the resistance method, Mr. Norris stated that the first reading should be taken one to one and one-half minutes after shutdown, and the curve should be extrapolated back to the instant of shutdown to arrive at the mean copper temperature during operation. He proposed that the ratio between allowable rise by resistance and that by thermometer for class-*B* machines be 1.43, and stated that both the theoretical results and tests given for ten machines showed that this ratio is suitable for present d-c machine design practice.

Following the general discussion F. E. Harrell (F '40) chairman of the AIEE committee on electric machinery, concluded the conference with an enjoinder to the committee to determine new engineering facts on hot-spot temperatures and their relation to the results with thermometers, thermocouples, and resistance methods, and to derive therefrom and establish safe performance levels.

SHORT-TIME RATED MACHINES

Three hours on Tuesday afternoon were devoted to studying permissible temperature rises of short-time rated machines. This conference likewise stemmed from Mr. Alger's Memorandum on Addendum to American Standard *C*–50, in which he proposed new limits for temperature rise by resistance on intermittent-rated machines, both a-c and d-c, including fractional- and integral-horsepower sizes.

Mr. Alger opened the conference with a summary of the questions on the agenda. He stated that the two important problems before the conference were (1) to determine what the temperature limits really should be and (2) to ascertain the relation of time to rated input. What should be included on the name plate of a machine was another consideration. Mr. Alger advanced the suggestion of marking the continuous rating and the maximum allowable input, or torque. Some further discussion was presented with reference to how and where the temperature can be determined best—whether by resistance, thermometer, or thermocouple.

The five informal papers which were presented thereafter provided considerable factual information of varying nature and a stimulus for open discussion. F. A. Compton, Jr., referring to his paper, "Temperature Limits and Measurements for Rating D-C Machines," illustrated by representative, or average, test curves the difference between resistance and thermometer readings versus hours running for various machine sizes. Although a ten per cent differential is recognized, his tests showed the differential to be much greater. His data pointed to the conclusion that the resistance method of temperature measurement was the best and most accurate, but that higher values should be adopted for the differential.

L. E. Miller commented on the preceding paper thus: "Mr. Compton . . . . . advances the idea that the short-time rating of d-c machinery is merely a gauge giving the user a conception of the physical size and torque capacity of the motor, but conveys nothing regarding the thermal capacity upon which the satisfactory life of the insulation depends. We entirely concur with this idea and further agree that the careful application of such motors, taking into account the duty cycle and the continuous thermal capacity has considerable effect upon the insulation life. The fact that two motors of different design are capable of meeting the same short-time rating but have entirely different rms capacities over a continuous period of time indicates the desirability of another form of rating so that the application engineer can apply motors intelligently to intermittent drives. Although we have no solution to offer as yet, we feel the problem should be studied."

C. B. Hathaway reported that on a given machine there seemed to be a definite relationship between the temperature rise by resistance and that by thermometer, but that, in the experience of his company one could not follow this through even on a line of similar machines, to say nothing of a group of machines of varying size and design.

T. E. M. Carville pointed out that since the values of temperatures by the various methods of measurement on continuous-rated motors appear to be percentages of the temperature rise rather than of the temperature differences between the two methods, it would be desirable to have the information calculated on the basis of actual temperatures. He also proclaimed a need for further tests on fractional-horsepower motors by the three methods for 15, 30, and 60 minutes before changing the limits. Actually, he concluded, short-time-rated motors are applied on a duty-cycle basis rather than on their rating. The rise by thermometer should not be changed but rather the rise by other methods should be determined and recognized.

W. R. Hough (M '41) Reliance Electric and Engineering Company, Cleveland, Ohio, concluded from an analysis of his test results that for totally enclosed machines it is illogical to have the differential between temperature rise by resistance and temperature rise by thermometer as a fixed increment independent of the rated temperature rise of the motor; a fixed ratio between the limits for the two methods would more closely match actual conditions in the range of rated temperatures. Mr. Hough also reported that, on the basis of his test results, the values proposed by Mr. Alger for the ratios of temperature rise by resistance to that by thermometer for half-hour-rated motors appeared too great. He suggested that the ratio fall within the range of 1.15 to 1.25. So few tests were made on open motors that no conclusions were derived therefrom.

It was brought out further that if the first readings on resistance–time curves are not taken within one minute after shutdown, the data obtained by extrapolating back to zero time is not a good approximation of true conditions. The over-all result of the conference was an indication that present factual information is not apodictic and does not justify any dependable conclusions regardin the relative magnitudes to be expected o resistance, thermometer, and thermocoupl readings.

F. E. Harrell (F '40) chairman of the AIE committee on electrical machinery, made few summary remarks before dismissing th conference. He expressed the intention o encouraging the presentation of papers during the next 6–12 months on the genera subject of hot-spot temperatures and intermittent loads.

Forecasting of Load Demands Occupies Application Conference

Load demands from military-camp and low-cost-housing installations; an explanation of qualities peculiar to nickel–chromiu alloys seldom taken into account in specifications; a short introduction to panel spac heating; a method of combating vibration i electrical contacts; and a survey of secondary protective devices were the diverse topic of discussion at the conference on domesti and commercial applications held during th recent AIEE winter technical meeting.

In his paper, "Data on Electric Loads o Wartime Projects," O. B. Falls, Jr. (A '39) General Electric Company, Schenectady, N. Y., presented data on electrified mess halls and on low-cost housing developments which he considered portentous: the first for an institution preparing food for large numbers of people, and the second for postwar planning of distribution systems in general.

Mr. Falls explained that his final load an demand factors for the mess hall were appreciably lower than those obtained in previou tests made of electric cooking loads in military establishments, because of the practice, in the particular hall studied, of turning o all food-preparation appliances and ovens a one time to keep the food warm. This produced a rather high peak for a short time. Mr. Falls believed that his lower figures fo the watt-hours consumed per man and th average diversified watts per man reflecte the greater efficiency of preparing food fo larger numbers of men, as previous test were made in camps having individual mes halls and kitchens for each barrack.

Mr. Falls classified his data covering a low cost housing development occupied entirel by enlisted personnel to conform to curves o diversified kilowatt demand and kilowatt hour consumption prepared for three group of conventional houses and other low-cos developments. The three groups studie were: houses that were completely electri fied (*A*); houses lacking only electric wate heaters (*B*); and houses lacking both electri water heaters and ranges (*C*). As was ex pected, the demand for the project studie by Mr. Falls was lower than for the conven tional housing for both the *A* and *B* group However, for the *C* group the demand wa higher than in the conventional-housin studies.

In an attempt to estimate the influence modern design of appliances on load deman Mr. Falls compared groups *A* and *B* whic represented a difference in demand due t water heaters. The relative difference b tween these groups was the same for th older studies and the more recent one. Th water heaters in all studies were similar i design. In the comparison of groups *B* an

hich represented a difference in demand
to the electric range, there was a dis-
ty between Mr. Falls' data and those of
older studies with the difference in de-
d between Mr. Falls' *B* and *C* groups
ively greater. As the ranges installed in
later project were of more recent design,
Falls concluded that modern appliances
be expected to add less to the peak load
older types.

etters from Mortimer Foster of the War
luction Board and J. D. Brooks (A '41)
ne Federal Housing Authority, praising
Falls' efforts were read. Mr. Foster
ed that the diversity in plans submitted
im resulted from either lack of load-de-
d data, or necessity for haste, or lack of
reciation of the now permanent need for
eme economy. The basic problem in his
ion is transformer-capacity estimation
e revision upward or downward to correct
rs in load assumption has become the

ne discusser raised the question of costs
ny projected electrification by pointing
the greater number of British thermal
s obtainable from oil or gas for one cent.
added that he thought perhaps more con-
ration should be given to electrifying the
ng pan, for example, instead of the range.
I. K. Brody (M '42) *McCall's Magazine*,
York, disputed this point by suggesting
the important consideration from the
umer's viewpoint is not the number of
units he can buy for his cent but the
unt of work he can perform for his unit
xpenditure. Mr. Brody read comments
Mr. Falls' paper from B. M. Jones
42) and C. N. Clark (A '36) Duquesne
ht Company, Pittsburgh, Pa. In the ter-
ry served by the Duquesne company,
er had been supplied to low-cost housing
elopments without water heaters or elec-
ranges at four kilovolts from the existing
ribution system with some extensions and
imum of reinforcing. The housing proj-
owned the primary distribution system
in their bounds as well as all transformers,
ndary systems, and in some cases street
ting equipment.
. B. Williams (M '37) *Electrical World*,
York, proposed establishment of a load-
arch foundation perhaps by co-operation
ng power companies. Given a set of
ditions, the engineer should be able to
cast demand, he said.
. E. Hanson, Ebasco Services, New York,
d a discussion prepared by W. F. Friend
ch declared that data such as Mr. Falls'
y be expected to elucidate trends of post-
utilization when political considerations
well as surplus generating capacity tend
ard further lowering of residential rates.
noted that the spread between maximum
minimum demand diminishes with the
rease in electrical facilities and supplied
results of a survey of the consumption of
average conventional dwelling using ap-
nces marketed before Pearl Harbor.
survey revealed that the low-cost-housing
sumption fell below the conventional
sumption except where complete electric
ice was supplied. Further analysis
wed that the water heater may be the
f cause of the inconsistency in the con-
ption data. Stating that some of the
jects studied by Mr. Falls were so far in
ess of normal in their demands as to be
pical examples of low-cost housing, Mr.
nd suggested that future studies should include: percentage of occupancy for the whole project, number of persons in average family, wage level of tenants, such building characteristics as presence of basement, insulation, quality of construction, kind of space-heating system, and fuel used, type of major kitchen appliances including automatic controls, type of electric rate (that is, whether wholesale metered and included in the rent or retail metered and paid as a separate bill by the tenant), and average unit cost.

W. A. Gatward, Hoskins Manufacturing Company, prefaced his paper, "Some Peculiar Features of Nickel Alloys," with the aside that the natural inclination of engineers to overload every piece of equipment presents a constant problem to the manufacturer. He confined most of his paper to consideration of the alloy of 80 per cent nickel and 20 per cent chromium which is standard for use in the manufacture of electric heating devices. Mr. Gatward spoke first of some problems arising for the manufacturer of nickel–chromium alloy from his desire to perfect his own product; secondly, he named five problems resulting from the demands of the user. The major interests of the user, he said, in the durability of the material and the wattage of a heating element when it is at operating temperature are interrelated with the resistivity of the metal at room temperature, the cross-sectional area or size, and the change in resistance when the element is heated. To meet these demands the producer must solve the following problems:

1. For every heavy wire or strip, the cross section can be measured more accurately and conveniently than the resistance per foot.

2. For small wires and ribbon, the ohms per foot can be measured more accurately than the cross section.

3. The utmost life must be obtained from the costly diamond dies which are worn quickly in drawing small wires.

4. The shape of the cross section of the ribbons of wire is not rectangular but thicker in the center and rounded at the edges, and therefore measurement is difficult.

5. The whole resistance problem is complicated by a peculiar effect of the rate of cooling on the resistivity.

The user would aid in solving the first three problems if he were to specify resistivity and ohms per foot, both with suitable limits, and say nothing about size tolerances. The size would then be consistent with the tolerances on the other two items. The fourth problem would vanish if the user would not tie the producer down to close tolerances on ribbon thickness, since this is measured by a weighting process not completely accurate. The fifth problem arises when the specifications allow too little resistivity tolerance. The resistivity of the metal at a given high temperature is more stable than at room temperature. Heavy wire is cooled more slowly than fine wire. Even though both are made from the same metal lot which has a resistivity at 1,600 degrees Fahrenheit of 160 ohms per circular-mil-foot, the fine wire will finish with a resistivity of about 620 and the heavy wire with about 655. When heated to 1,600 degrees Fahrenheit, one will rise eight per cent and one only two per cent. Therefore for preliminary calculations he advised the user to employ average values which are quite accurate for the sizes of wire used in most domestic devices.

F. W. Hutchinson, University of California, Berkeley, presented a few slides and a short explanation of panel space heating in an effort to sound out the amount of interest in a paper describing a design procedure for panel space heating which might be prepared for the St. Louis meeting of the AIEE in June 1944 and for which several related papers already are scheduled. Mr. Hutchinson stated that the heating, actually a hot-water system, is not done by electricity but that most of the systems installed in Europe, particularly in England, are operated electrically. In panel-type heating, which depends on radiation for its effectiveness, the heat is radiated from walls covered with a fabric applied in strips similar in appearance to wallpaper, to a predetermined comfort zone of the room. No heat is lost in heating the walls or the air. The heat is concentrated where it will warm the human beings in the room most effectively. To an inquiry about the amount of saving effected by use of the panel heating system compared with the usual hot-water heating system, Mr. Hutchinson answered that savings of at least 10 to 15 per cent could be expected because of the lower air temperatures possible. He pointed out that savings would increase as ventilation increased.

Stephen Jones, Heinemann Circuit Breaker Company, presented the paper, "A Survey of Secondary Protection and Protective Devices." The four types of protective devices available at present, the electrothermal, electrothermal mechanical, the electrothermal electromagnetic mechanical, and the electromagnetic mechanical, were considered in the chronological order of their development. Each type was treated for its fulfillment of the primary qualifications of inverse time–overload characteristic, instantaneous trip control, low power absorption, high current-rupturing capacity, automatic operation free of the handle, resetability, tamperproof construction, maintenance of rating, high dielectric strength, least size and weight consistent with its application.

AIEE technical paper 44-69 (scheduled for publication in the April 1944 Transactions section) entitled "The Vibration of Electrical Contacts," was presented by M. N. Russell and Saul Keilien, Pass and Seymour, Inc., Syracuse, N. Y. Discussion of this paper brought out the fact that experience had proved the advantage of providing a resilient contact for operation under conditions of severe vibration. It was also stated that data obtained thus far were inconsistent and that a differentiation between domestic and commercial contacts is needed.

W. F. Ogden (M '41) chairman of the committee on domestic and commercial applications, presided at the conference.

Electrical Measurements Subject of Two Winter Meeting Sessions

Instruments for electrical measurements and their application furnished the subject of two sessions of the recent AIEE winter technical meeting, on Monday, January 24, a morning session on electrical measuring instruments under the sponsorship of the instruments and measurements committee, and an afternoon session on application of electrical measurements and basic sciences, sponsored jointly by the instruments and measurements and basic sciences committees.

C. L. Dawes, chairman of the instruments and measurements committee, presided at the morning session. Over 90 members and guests attended. In the first paper, "A Multiple-Deflection A-C Potentiometer" by R. B. Marshall (A '40) of Purdue University, Lafayette, Ind., the author described an ingenious method by which impedances from very low to very high values can be measured by an a-c-potentiometer method employing ordinary indicating instruments. The paper was discussed by P. A. Borden (M '19) of the Bristol Company, Waterbury, Conn., E. D. Doyle (F '27) and A. J. Williams, Jr. (A '27) of Leeds and Northrup Company, Philadelphia, Pa., and Walther Richter (F '42) consulting engineer, Milwaukee, Wis. Walther Richter then presented a paper, "An Instrument for the Measurement of Large Alternating Currents." The method involves a mutual inductance wound on an openable flexible nonmagnetic core which can be linked with the current to be measured. By means of a resistor–capacitor circuit and an amplifier, an accurate reproduction of large currents such as welding currents can be obtained and shown on an oscilloscope. The paper was discussed by E. D. Doyle. In a third paper, "Crossed-Coil Power-Factor Meters," presented by the author, N. P. Millar of the General Electric Company, the equations for the Tuma phase meter were first derived. From these equations, the author shows methods whereby the scales of power-factor meters for single-phase and polyphase circuits can be controlled and designed, as for example, by changing the angle between the coils and the position of the pointer. The paper was discussed by P. A. Borden, and Paul MacGahan (F '42), Westinghouse Electric and Manufacturing Company, Newark, N. J. A considerable portion of the discussion centered on the significance of power factor in an unbalanced three-phase system. The last paper of the session, "Influence of Improved Magnetic Alloys on Design Trends of Electrical Instruments" by M. S. Wilson (M '43) and J. M. Whittenton (A '37) of the General Electric Company, Lynn, Mass., was presented by Mr. Whittenton. The paper gave the permanent-magnet properties of the several alloys used for instrument magnets and showed how, with the improved alloys, the size of instruments could be materially reduced and yet the performance improved. The authors pointed out that the ideal magnet material should have high coercive force, residual induction, and available energy, and also good fabricating qualities. A material which approaches these qualifications is a new cobalt–molybdenum–iron alloy known as "Comol," although its magnetic characteristics are inferior to those of the Alnico group. By the use of this material and internal pivot construction, a compact panel-type instrument with better over-all characteristics has become available. The paper was discussed by L. W. Matsch (M '41) of the Commonwealth Edison Company, Chicago, Ill., and Paul MacGahan.

Electrical means for solving mathematical and transient-heat-flow problems was a major topic at the afternoon session. More than 100 members and guests attended the session at which T. S. Gray, vice-chairman of the committee on instruments and measurements, and R. W. Ager, chairman of the committee on basic sciences, presided jointly.

Description of a complete electric network for studies of transient heat flow was included in the first paper, "The Accuracy of Measurements in Lumped *R-C* Cable Circuits As Used in the Study of Transient Heat Flow," by Victor Paschkis and Michael P. Heisler of Columbia University, New York. The paper was presented by Mr. Paschkis, who described the inherent limitations on the accuracy of the method brought about by the leakage in the capacitors and the lumps in the circuit. R. J. Wiseman (F '27) of the Okonite Company, Passaic, N. J., discussed the paper.

A servo system that places no load or restraint on the shaft being followed was described in the second paper entitled "Polarized Light Servo System," by T. M. Berry (A '43) of the General Electric Company, Schenectady, N. Y., which was presented by the author. The presentation was clarified by a demonstration projected on the screen by a lantern-slide projector, and applications of the system to a device for studying flow phenomena through turbine passages and to a differential analyzer were mentioned. Discussion of the paper was deferred until after the presentation of the third and companion paper entitled, "A New Differential Analyzer," by H. P. Kuehni and H. A. Peterson (M '41) of the General Electric Company, Schenectady, N. Y. In his presentation, Mr. Kuehni mentioned various improvements over previous instruments including use of the new servo system described in the previous paper. The tremendous power of the differential analyzer as a mathematical tool and its importance in the war program were emphasized. Written discussions of both the second and third papers by F. J. Maginniss of the General Electric Company were read by C. Concordia (M '37) of the same company. A. E. Harrison (A '39) of the Sperry Gyroscope Company, Inc., Garden City, N. Y., R. W. Ager (M '41) of Cornell University, Ithaca, N. Y., and J. R. Pattee (M '42) of the Bristol Company, Waterbury, Conn., discussed the paper by Mr. Berry. Comments on the paper by Kuehni and Peterson were offered by C. N. Weygandt (A '37) of the University of Pennsylvania, Philadelphia, Pa.; H. Poritsky of the General Electric Company; E. W. Kimbark (M '35) of Northwestern Technological Institute (on leave at the Massachusetts Institute of Technology, Cambridge, Mass.); and E. S. Lee (F '30) of the General Electric Company, Schenectady, N. Y. The discussion of the two papers was closed by Berry and Peterson.

Under the sponsorship of the committee on basic sciences, a paper entitled "Symmetrical-Component Analysis of the Four-Phase System," by A. Boyajian (F '26) of the General Electric Company, Pittsfield, Mass., was presented by C. Concordia of the same company. It stressed a new basis for symmetry among the members of the sets of components. A written discussion of the paper by A. N. Garin (M 37) of the General Electric Company, Pittsfield, Mass., was read by G. Camilli (F '43) of the same company. Further discussion was offered by E. W. Kimbark, followed by closing remarks by C. Concordia.

The final paper entitled "Some Aspects of Inductance When Iron Is Present," by L. T. Rader (A '34) and E. C. Litscher of the General Electric Company, Schenectady, N. Y., was presented by Mr. Litscher. Wide disparity of results may occur in a particular problem depending on which of the various definitions of inductance is used in its solution. The significance of the definitions and their use in the analysis of different applications were described. The paper was discussed by C. Concordia, Walther Richter, and E. H. Vett, University of Illinois, Urbana. (*C. L. Dawes, chairman, and T. S. Gray, vice-chairman, AIEE committee on instruments and measurements.*)

Needs of Industry Stressed at Power-Application Conference

Motor control, circuit breakers, lightning protection, plant distribution systems, and induction heating were the subjects discussed at the conference on industrial power applications held recently during the AIEE winter technical meeting. Herbert Speight, vice chairman of the AIEE committee on industrial power applications, opened the meeting; after the presentation of the first paper, he introduced R. C. R. Schulze, chairman, subcommittee on service and switching, who presided thereafter.

The first paper (44-18) on the program was "Inverter Action on Reversing of Thyratron Motor Control," by H. L. Palmer and H. H. Leigh (A '39), both of General Electric Company, Schenectady, N. Y. This paper is scheduled for future publication in the Transactions section of *Electrical Engineering*. Two papers listed for this conference were not presented because of the absence of their authors.

L. C. Peterman, of Ford, Bacon, and Davis, Inc., New York, stated that his paper, "Experience With Short Circuits and Breakers," was concerned primarily with circuits of 600 volts and less. The short circuits and low-resistance grounds discussed were only those developed from defective or damaged equipment. The author pointed out that, in the low-voltage field where direct-acting breakers have greater operating speed than any high-speed relay and oil-breaker combination, there have been no real developments in securing selectivity and adequate co-ordination. Mr. Peterman objected to the manufacturer's advocating the cascading of breakers in order to protect a low-voltage system, characterizing this as unsound engineering. Although this arrangement is more economical, the management of the plant is likely to ignore the monetary saving when it discovers that cascading may cause the entire plant to shut down. Mr. Peterman stated that the most urgent needs in industrial plants are adjustable trip ratings for all types of breakers and true and dependable selectivity coupled with high-speed tripping from direct-acting mechanism. The author said that availability of these items will widen the field for the application of low-voltage breakers to all industrial plants.

B. M. Jones (M '42) Duquesne Light Company, Pittsburgh, Pa., in his discussion of Peterman's paper, agreed with the basic fundamentals therein. He stated that a sound engineering analysis of the subject should be made, and that he thought selectivity is just as essential on low-voltage circuits as on high-voltage circuits.

The general theme of the third paper on the conference program was protection against lightning for industrial equipment in coal mines, as reported by A. C. Muir (M '39) Berwind-White Coal Mining Company, Philadelphia, Pa. In his presentation, the author compared the early use of electric mine locomotives and oxide-film lightning arresters with the improvements and developments of equipment and protection of today.

"Beginning in 1937," Mr. Muir continued, "pellet-type distribution arresters were installed on the lines and protective capacitors were installed on the 6,600-volt busses. The electrolytic and oxide-film arresters have been taken out as their condition warranted and replaced by station-type Thyrite arresters. Originally lightning protection consisted of one arrester at each station. Several years ago, new protective equipment was installed at these mines" (Minden, W. Va.). "Thyrite station-type arresters were installed on the 2,300-volt busses at the station. Protective capacitors were installed. Pellet-type distribution arresters were installed on the transmission lines leading to the substations. Before putting in the modern protection, we had several machines out of service each season because of lightning. No machines were damaged the first year the equipment was installed, and we have had only two failures since then due to lightning."

Mr. Muir stated that protection of the a-c rotating equipment has been obtained by combining overhead ground wire with frequent ground connections, pellet-type distribution arresters on the lines, and protective capacitors and station arresters at the stations. At least there has been less trouble attributable to lightning since the installation of such protective devices.

One of the most constructive discussions of Muir's paper was presented extemporaneously by W. H. Collins (M '30) Board of Water and Electric Light Commissioners, Lansing, Mich., who stated that he was interested in lightning protection in the distribution field. He confirmed the content of the paper as being in keeping with his experience in that field. Mr. Collins commented on the delayed discovery of these protective devices and on the fact that lightning arresters still are not being used in industry to full extent. There is no sound reason for industry not to utilize arresters, as they are an inexpensive form of protection, and there is a definite need for further safety.

A paper concerned with the wartime changes being made in the distribution systems of industrial plants was read by A. F. Bowers, General Electric Company, Philadelphia, Pa., who assisted C. E. Smith, New York Shipbuilding Corporation, New York, N. Y., in the preparation. The theme of the paper consisted of the rapid expansion of industrial plants in this wartime era and the complications of extending distribution systems in these plants. "Cost became secondary to time," Mr. Bowers stated. "The design depended on the availability of materials, equipment, labor, the design of the existing system, and the necessity of maintenance of service during the period of the expansion program." Examples of specific instances of reconstruction in a large shipyard were included.

The final paper to be presented at the conference was "Induction-Heating Applications," by Howard E. Somes, Budd Induction Heating, Inc., Detroit, Mich. Mr. Somes reported that induction-heating applications primarily must be divided into two groups: nonselective heating and local or differential heating. "In general," the author claimed, "nonselective heating is useful for paint drying, annealing, forging, and like applications. . . . For local or differential heating, electromagnetic induction or flame represent the two outstanding means of selective heating." In the application of nonselective-type heating, especially for forging, Mr. Somes declared that the Budd Company considers that its many advantages, such as savings of material and reduced cost of scale removal, more than offset the increased cost of electric energy which must be supplied as a source of heat.

The author illustrated verbally several methods of utilizing induction heating by his company. Among them were:

1. The brazing of a burster tube into a shell body.

2. Selective heat treatment of tubular bodies, such as internal-combustion-engine cylinder liners, compressor cylinder liners, slush-pump cylinder liners.

3. Hardening of tank track pins, piston pins, and other small parts.

Mr. Somes concluded his paper by stating that "The science or art of heat treatment is today a very vital and important part of industry. The future growth of induction heat treatment will be contingent largely on the close co-operation between the designing engineer, the metallurgist, the heat treater, and the electrical industry."

Administrative Problems of the ASTP and NCTP Discussed

An open conference was held on the afternoon of January 28 at the AIEE winter technical meeting for discussion of the problems encountered in the administration of the Army and Navy Specialized Training Programs. Robin Beach (F '35) chairman of the AIEE committee on education presided over the session, which was attended largely by engineering professors from the colleges and universities at which the programs are being discharged.

Lieutenant Colonel F. H. Pumphrey (M '25) chief of the engineering division, Army Specialized Training Division, and Commander A. S. Adams, USN, retired, with the Bureau of Navy Personnel, Washington, D. C., led the discussion after reviewing the aims of the respective programs and their development thus far. Colonel Pumphrey took the floor for the Army first, and outlined certain anticipated changes in the ASTP for which final approval was expected shortly before being formally announced. The alterations were based on recommendations derived from the experience of the participating institutions and were incorporated in a revised curriculum to become effective for advance-phase engineering students in all terms on or about April 1.

According to Colonel Pumphrey, in setting up the ASTP, the first requirement that seemed indicated was training in leadership—in the ability to analyze a local situation, to draw accurate conclusions, and to initiate effective action. When the advanced-phase engineering curricula were prepared originally, extensive training in problem solution and laboratory experimentation was included towards achieving these objectives.

It was also assumed that the minimum essentials of an engineering course should be given in order to prepare these selected soldiers as technical officers. The time limitation of three or four terms beyond the basic phase was set by higher authority. Since the duties of junior officers are normally restricted to operations and maintenance, only enough design work was included to give necessary drill in the theory, and to provide an integration of the knowledge gained in the other courses.

The original objectives of the ASTP have remained fundamentally unchanged, he continued but some modifications in the direction of providing a terminal point earlier in the schedule were necessitated, since it is no longer expected that graduates will be assigned directly to Officer Candidate School but rather to duty as technical noncommissioned officers. In particular, the revisions of the course outlines for the advanced phase are as follows:

In the Term IV course in calculus, emphasis is no longer given to differential equations. Extremely close co-ordination of the courses in mathematics and mechanics is requested especially in problems involving first and second moments. Close co-ordination is requested, also, between the course in electric and magnetic phenomena, and the course in electric measurements.

In Term V, the titles of the course in circuits and the course in applied mathematics have been changed so as to describe better the course content. It is expected that the course now called engineering applications of mathematics will be taught in the electrical engineering department and as a course in the application of mathematical procedures rather than a course in theoretical mathematics.

In Term VI, a course in telephone circuits and equipment has been added in order to provide a more effective training program for the trainees for whom Term VI is terminal. This course replaces the courses in transients and in distributed parameter circuits.

In Term VII, the addition of the topics of transients, trigger circuits, and pulse-shaping circuits to the course on communication networks has been made possible by the introduction of a portion of the material on communication networks into the telephone course in the previous Term. The course in radiation and propagation has been omitted and these topics have been included in the ultrahigh-frequency course. Since no course in transients is given, two contact hours have been added to the servomechanism course, in which transients are discussed as their applications arise.

Commander Adams then described the Navy V–12 program as it was planned and as it is unfolding. "The single and sole reason for the existence of the V–12 program is for the benefit of the Navy to win the war at the earliest possible moment," he declared. According to him, four basic principles underlie its organization and determine its developing policy. These are:

1. The Navy, having derived considerable advantage from the colleges and universities in the United States in the past, desires to conserve every possible value in higher education.

2. The Navy finds it desirable to disrupt normal academic procedures as little as possible.

3. No institution is to be penalized financially.

4. Word as to the developing policy will be sent to the administrators of the program as early as possible.

The matter of selecting and assigning the several thousand students who comprise the Navy College Training Program enrollment, Commander Adams declared, is the most challenging problem today. The screening tests which determine the eligibility of the student candidates for V–12 classification and possible advanced ratings are based on three considerations. First of all the student is asked his choice as to the upper level in which he wishes to go. Then an examination is made of his previous academic record, his qualifying examination, his record as an apprentice seaman, and a report of his aptitudes and attitude as expressed by his commanding officer. Final allocation is determined by the Navy's need at the particular moment for trainees in the area of his choice and qualification.

The Navy doesn't want to confuse activity with achievement, Commander Adams continued, and it doesn't want to interfere with the academic standing of any of the participating institutions. For the most part, all those who have passed the qualifying examinations should be allowed to remain through the third term, but if the instructors believe that a student should not be continued, he should be separated. The road ahead is hard, and these boys must know, they must have the power that comes from certain knowledge. One does not get a second guess in naval operations of today. Some of the most important naval engagements in this war have been over in an hour or two, and the fate of half a dozen ships settled in that brief time.

During the open discussion which followed, many local problems of administration in both the ASTP and the V–12 programs as they existed at the various centers of training were explained, and those not requiring special military information were answered satisfactorily. The character of the discussions gave clear indication that the programs of specialized training were being administered effectively, and that the engineering colleges are doing a fine job of equipping a large personnel to assume more responsible roles in the technical phases of the present highly scientific modes of warfare.

Before the conference was turned over to consideration of the specialized training programs for the Army and Navy, Aram Boyajian (F '26) General Electric Company, Pittsfield, Mass., presented a paper on "The Cultural Training of the Engineer" (*AIEE Trans, Jan '44, pp 6–8*).

Principles and Performance Covered at Relaying Conference

Practical criteria for determining the type and location of faults requiring high-speed relaying to maintain transient system stability were outlined briefly by R. C. R. Schulze (M '31) Public Service Electric and Gas Company, Newark, N. J., in his paper, "Effect of Relay Operating Time on System Stability," presented at the conference on speed relaying held during the recent AIEE winter technical meeting.

Instability is likely to occur, he said, when the change in the relative phase position of an impaired machine and the remainder of the system exceeds an angle of 120 degrees. Sometimes delaying the relaying time may permit the machine to swing so far away from the system that it becomes impossible to pull it back into synchronism. In considering the various factors active in system stability he pointed out that anything diminishing the megawatts available for displacement decreases the need for speed relaying. "Any load connected directly to the generator bus will act as a cushion and will reduce the amount of phase-angle displacement, unless the fault is directly on the terminals of the generator itself, or the bus to which it is connected," he declared. Where turbine output is high, he recommended either a minimum of exposure between the generator terminals and wound equipment such as transformers or reactors, or a low-pressure slow-speed machine directly in parallel with the high-pressure unit to act as a brake. Other factors entering into the problem are system design and the amount of impedance to the fault. If the phase positions of the machines of a system change together, slower relays are possible, but, when one machine is likely to be affected more than the others, time is of greater import. A fault adjacent to a generator station must be cleared quickly whereas a fault on a distribution feeder probably can hang on indefinitely, he said.

Characterizing the method as a reliable and highly effective means of combating the stability problem, C. E. Parks (A '40) Public Service Company of Indiana, Indianapolis, described the performance of single-pole relaying and switching on a 50-mile 132-kv interconnecting line in his paper, "Influence of High-Speed Relays and Reclosing on Over-All System Performance." This scheme utilizes the fact that, since a large percentage of the faults on a modern transmission system are phase to ground, isolation of the faulted phase only will cause much less shock to the system involved in the fault than would be the case if the entire system were isolated. Synchronizing current will pass over the unfaulted phases during the time the faulted phase is isolated, and both systems will remain more stable for a longer period of time than they would with no interconnection at all.

The benefits of high-speed reclosing also have been demonstrated for the Public Service Company by another 73-mile section of 66-kv line, built on wood poles without static wire and protected by high-speed carrier-current relaying and three-pole reclosing. During 20 months of operation the line has been in fault 131 times. Of these faults 110 reclosed successfully while 8 were caused by permanent faults on the line. The customer complaint that formerly accompanied each one-minute interruption of service subsided when the reclosing was placed in service, Mr. Parks stated.

A selected amount of operating experience with short-circuits and faults on the lines and equipment of a representative central station was presented by H. R. Paxson (M '40) Philadelphia (Pa.) Electric Company, in his paper, "The Effect of Relay Operating Time on Damage to Equipment and Lines." Valuable statistical information on lines and equipment used on various voltage systems and fault records for diverse types of line construction were included.

The territory of the Philadelphia Electric Company described by Mr. Paxson, covers approximately 2200 square miles, and comprises distribution systems operating at 220 kv, 66 kv, 33 kv, 13.2 kv, and 2.4 kv. Data collected on the 220- and 66-kv systems, which are both equipped with high-speed relaying devices, between 1935 and 1942 showed that for the majority of interruptions involving aerial lines no conductor burn downs or serious line damage occurred. Mr. Paxson attributed this excellent record partially to the high-speed devices. On the 33-kv system where there is considerable time delay in relaying it was noted that although the number of interruptions was high the percentage of successful reclosures also was high. This led Mr. Paxson to suggest other factors besides relay settings which may influence the number of burn downs. He stated that the use of relatively large, bare conductors with wide spacings reduces the probability of burn downs since weatherproof covering on conductors tends to confine an arc to one spot on the conductor with consequent burn down. This theory was borne out by his data on the 13.2-kv system which is protected by slow relays and for which municipal ordinance requires weatherproof covering.

In analyzing the effects of time delay, Mr. Paxson reviewed specific faults cleared by slow relaying and by high-speed relaying. He mentioned two cases of frequency converters pulling out of step on the 66-kv system: one before and one after high-speed relaying had been installed. Extensive damage was entailed in the first case and was absent in the second. A bus fault on the 66-kv system before differential protection was installed was communicated to other equipment with an average outage of 17 minutes. After the installation of high-speed relaying, a circuit breaker exploded with no associated damage and another fault resulted in very little burning.

The discussion following the presentation of the papers stressed the benefit of relaying improvements in serving the customer but posed the question of whether it is always economically justified from the standpoint of furnishing more kilowatts at less cost.

One discusser stated that speed relaying should be confined to relaying out parallel lines. He added that the method was applied best in faults involving two interconnected load feeders and that for a cable fault in a substation no relaying seemed necessary at even so short a distance as a mile from the critical area.

E. L. Harder (M '41) chairman of the subcommittee on high-speed relaying, presided at the conference.

Turbogenerator Characteristics Discussed at January Meeting

Three basic characteristics of turbogenerators—ratio of generator rating to turbine rating, power-factor rating, and short-circuit ratio—were the subject of discussion at the conference on turbogenerator characteristics held January 25 during the AIEE winter technical meeting. The conference was attended by a large number of engineers representing users and manufacturers, with resultant valuable discussion that will aid the AIEE–ASME Joint Committee on Turbogenerators in its standardization project. M. S. Oldacre, chairman of the AIEE group of the Joint Committee, presided.

A report was presented by the AIEE group giving the results of questionnaires sent to about 95 members of the AIEE electrical machinery and power generation committees, Edison Electric Institute electric equipment committee and interested utilities. Replies were received from representatives of over 40 operating companies representing in excess of 15,000,000 kw of installed generating capacity. With the additional information presented during the discussion, the data now available are representative of over 18,000,000 kw of installed generating capacity, or in excess of half of the steam generating capacity of the United States.

The committee is concerned with units of 10,000-kw capacity and above, and for the present is confining its work to 3,600-rpm units, for which the ASME group has recommended ratings of 12,500, 20,000, 30,000, 40,000 and 60,000 kw. Each of these units will have a guaranteed maximum capacity of ten per cent above its nominal rating. In many cases in the recent past, units have been given a name-plate rating of 80 per cent of the maximum capability of the turbine and the generator has been given an 80 per cent power-factor rating. To develop full kilowatt capacity of the turbine, it has been necessary to operate the generator at unity power factor. This 80 per cent rating basis, or conversely the 25 per cent margin of turbine capacity above generator kilowatt name-plate rating, will be superseded by only a ten per cent margin if the ASME recommendations are adopted.

The two questions of most immediate concern are the power-factor rating of the generator, and the short-circuit ratio as an indication of the stability of the unit under steady-state and transient conditions.

The questionnaire and discussions emphasized that there has been a lack of proper co-ordination between the turbine and generator capabilities which in many cases resulted in the turbine-generator units being deficient in kilovar capability at the high loads with the present 80 per cent power-factor generators and 125 per cent maximum turbine rating; lack of co-ordination also existed in other parts of the plant, for example, in the capability of the boiler plant with that of the turbogenerator.

The manufacturer representatives in the AIEE group discussed the effect on the generator if some of its characteristics were changed, and pointed out that they were desirous of standardization for the progress that it would mean but that they had no preconceived program of characteristics that should be adopted for standardization purposes.

The conference was of considerable benefit, and from the information presented there and the discussion it has stimulated, the AIEE group is continuing its work so that it can recommend a standardized program. When the AIEE recommendations have been prepared and adopted, it is intended that they should be published jointly with the recommendations of the ASME as a complete report on turbogenerator standardization. (*M. S. Oldacre, chairman AIEE group, AIEE–ASME Joint Committee on Turbogenerators.*)

(Left) R. T. Henry of the Buffalo, Niagara, and Eastern Power Corporation; J. E. Hobson of the Illinois Institute of Technology, C. M. Laffoon of the Westinghouse Electric and Manufacturing Company, J. E. Housley of the Aluminum Company of America, and M. D. Ross of the Westinghouse company, were photographed in the lobby of the Engineers' Building while attending the winter meeting

(Above) Chatting between sessions at the winter meeting are H. N. Muller, Jr., Westinghouse Electric and Manufacturing Company, G. E. Dana, New York State Electric and Gas Corporation, G. Steeb, Buffalo, Niagara and Eastern Power Corporation, J. R. Stover, New York State Corporation, and L. J. Audlin, Central New York Power Corporation

Standards and Performance Topics of Industrial-Control Conference

Proposed standards for, and performance of, industrial-control devices were the main topics for discussion at the conference on industrial control, held January 26, during the AIEE winter technical meeting. E. H. Alexander (M '43), General Electric Company, Schenectady, N. Y., presided.

L. T. Rader (A '34) General Electric Company, Schenectady, N. Y., outlined the existing need of standards for industrial-control devices. In the opening lines of his paper he declared that until now there has been no subcommittee on industrial control, and for that reason many control problems of vital importance have remained undiscussed. Doctor Rader pointed out that, since the requirements of the different divisions of industrial control vary so widely, standards for these divisions may vary, and "the need definitely exists for somebody to set up some standards." He enumerated nine topics which he claimed should have specific standards. These were:

1. Specification of arc-interrupting ability of a-c contactors.
2. Definition of "inductive load" when associated with d-c interruption.
3. Allowable temperature rise of contactor tips.
4. Allowable temperature of coil insulation.
5. Current–time characteristics of overload relays.
6. Specifications to limit voltage surges caused by d-c switching.
7. An immediate overhauling of present standards to fit them to the low-power control circuits in electronic controls.
8. Allowable cooling-air temperatures for forced-convection resistors when the air ducts travel through various kinds of building material.
9. A reasonable ambient temperature for various applications, since ambient temperature affects coil and contact tip heating so critically.

As a substitution for the paper originally scheduled for presentation by E. H. Alexander, R. A. Andrews, Ward Leonard Electric Company, Mount Vernon, N. Y., introduced "Electronic Speed Regulation." Mr. Andrews stated that uses for speed regulation in industry are increasing steadily. He pointed out that an electronic speed regulator consists of three basic elements: a power detector, an amplifier, and a power unit.

At the conclusion of this paper E. H. Alexander offered the following comment:

"The electron tube is now, to the electrical engineer, just another tool added to his well-filled 'tool chest.' Often its choice for an application results in doing a better job than was ever done before."

P. L. Hoover (M '39) Case School of Applied Science, Cleveland, Ohio, offered an alternative to the designation Mr. Andrews gave the elements of a speed regulator. He said that in teaching he found it much more appropriate to substitute the terms measuring element, translator, and amplifier in place of those given by the author.

G. A. Moffett, General Electric Company, Schenectady, N. Y., spoke on "Overload Protective Devices for A-C Induction Motors." Mr. Moffett announced that, after a brief review of the occurrences within and about a motor subjected to overloads at and within the range of stalled conditions, he would offer three specific questions with the purpose of provoking discussion. He said that investigations have proved that practically all failures occur from one of these five causes:

1. Continuous overload caused by excessive load or by a low line voltage.

2. Equivalent of one caused by a duty cycle where rms current exceeds the motor rating or by a too frequent start–stop duty cycle.

3. Stalled rotor due to excessive load, causing the motor to fail to start—a condition which gives approximately 600 per cent rated current for an average d-c motor.

4. Stalled rotor due to single phasing of the power supply—a condition which gives about 86 per cent of the three-phase stalled current or about 500 per cent of rated full-load current of an average a-c motor.

5. Excessively high ambient temperatures. Standard general-purpose motors are designed to operate in a maximum occasional ambient temperature of 40 degrees centigrade, and, if fully loaded in a higher ambient, the motor will overheat.

Mr. Moffett stated that to protect a motor adequately an overload relay must give running protection and, in addition, be fast enough to remove the motor from the line within the allowable stalled time, with only 86 per cent of the three-phase locked-rotor motor current flowing in the relay. After this review the author presented the following questions:

"1. Should we continue to attempt to build relays having heating characteristics closely approximating those of the motors—relays that provide both running and stalled protection—or should we concentrate on a good, reliable, small, and inexpensive device that makes provision only for stalled protection?

"2. Assuming that present practice is to be followed, should we have one relay providing a single characteristic, or should there be more, say three, one designated as fast, one medium, and one slow, and if so, what should be the established trip time at 600 per cent relay rating?

"3. Should we continue present practice, or should the manufacturers provide ambient compensated relays for general-purpose applications?"

The final paper to be presented at this conference was "The Behavior of Rectifier Circuits Supplying Industrial-Control Devices" by E. E. Moyer and P. T. Chin (A '41), both of General Electric Company, Schenectady, N. Y. The subject matter was confined to inductive loads, such as the coils of relays and contactors, and field windings of rotating machines. A comparison was made between the behavior of a circuit comprising resistance and inductance in series when supplied from a source of pure direct current and when it was supplied from a rectifier. The authors had prepared a number of slides illustrating their subject. These included diagrams showing the rise of current in a circuit comprising resistance and inductance in series, wave forms of a half-wave rectifier, graphical presentation of the meaning of average and rms values of a current pulse, comparison of a battery-energized circuit with a half-wave "free-wheeling" type of rectifier circuit, analysis of a controlled-rectifier output-voltage wave into its component sine waves, and some others.

Co-operation Theme of Conference on Civic Affairs

Co-operation of AIEE with cognate technical societies, with other professional groups, and with civic bodies was discussed at the conference on civic affairs and co-operation with other organizations during the recent AIEE winter technical meeting. H. W. Bibber, vice-chairman of the technical program committee, presided.

The consensus of opinion was that co-operation should be handled by local groups with simple organization and on specific subjects, and that co-operation tended to break down when a superstructure was built to supervise it.

P. L. Alger (F '30) of General Electric Company, Schenectady, N. Y., past chairman of the technical program committee, suggested that each AIEE committee should survey its field of interest and follow through one certain aspect of co-operation with other societies. The co-operating societies should invite each other to meetings of mutual interest and exchange programs and papers.

Resistance and arc welding have increased tremendously with the war program, declared G. W. Garman (A '38) of General Electric Company, Schenectady, N. Y., member of the AIEE electric welding committee, who urged co-operation between AIEE and the American Welding Society in the publication of papers and Standards of mutual interest.

The Radio Technical Planning Board which now has about 12 sponsors was cited by H. M. Turner (M '20) of Yale University, New Haven, Conn., as an example of bringing engineers together for effective co-operation. He proposed an advisory organization of all electrical people to submit recommendations to Congress and to other groups (*EE, Dec '43, pp 557–8*).

The New York Section has held many meetings jointly with other societies, announced M. D. Hooven (M '30) of Public Service Electric and Gas Company, Newark, N. J., vice-chairman of that Section. Joint meetings are held with the Illuminating Engineering Society, and the communications group often meets in conjunction with IRE. He proposed national solidification of these joint groups.

C. W. Fick (F '39) of General Electric Company, Cleveland, Ohio, said that the Cleveland Engineering Society building serves as a bond among the 23 engineering societies in that city, and that the societies also have a common publication; he declared that a like situation existed in Cincinnati. Experience in Kansas City, however, indicated that joint interest and a common bulletin were not sufficient to keep a group together, according to V. P. Hessler (F '43) of the University of Kansas, Lawrence, chairman of the Kansas City Section, but that an important joint project was necessary. Co-operative work on a community scientific library has helped cement joint-group interests in Kansas City during the past year. He recommended publication of news of local joint activities in *Electrical Engineering* as a means of affording other local groups ideas on co-operation.

Past President D. C. Jackson (F '12), Massachusetts Institute of Technology, Cambridge, cautioned against permitting one organization to undertake the problem of guidance in the formation of a joint society, but advocated allowing the society to act as a center and a host without control. If engineers wish to take community action on any issues, they must have unity of action among themselves first, he declared, and suggested the ECPD canons of ethics as a means of unifying engineers when they join together to accomplish a common objective.

Such issues as the collective-bargaining battle being conducted by American Society of Civil Engineers should be tackled by all engineers as a group, and not by one society nor by the societies individually, said Vice-President C. W. Ricker (M '36), Tulane University, New Orleans, La. He recommended the holding of a national meeting of district leaders of the various societies to plan and foster co-operation. The AIEE board of directors has authorized appointment of a committee to study conditions affecting the securing of employment and compensation among electrical engineers with special reference to problems of collective bargaining and has requested that this committee collaborate with a corresponding committee of ASME. Details are given in a separate item.

The setting up of separate joint organizations to handle special problems rather than large general organizations to cover numerous issues was advocated by J. F. Fairman (F '35) of Consolidated Edison Company of New York, Inc. He cited Engineering Council for Professional Development which has been involved in the selection, guidance, and training of young engineers for 11 years as an example of a co-operative enterprise among engineering societies (*EE, Dec '43, pp 556–7*).

Past President D. C. Prince (F '26), General Electric Company, Schenectady, N. Y., recommended that the Sections committee and the technical program committee should organize programs with other societies, and that joint subcommittees of these organizations should be formed in the Sections to sponsor co-operation.

Joint Session on Generation, Transmission, and Distribution

Four papers featured the joint session on power generation and transmission and distribution January 24, during the recent AIEE winter technical meeting, two papers dealing with the effect of loads on a-c generators under steady-state and transient conditions, one concerned with lightning protection for rotating machines when connected directly to overhead lines, and one discussing the effect of kilovar supply on system design. A. C. Monteith, chairman of the committee on power generation, and H. E. Wulfing, chairman of the committee on power transmission and distribution, both presided.

Paper 44-15, "Regulation of A-C Generators With Suddenly Applied Loads," by E. L. Harder (M '41) and R. C. Cheek (A '42), both of Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., concerns chiefly the sudden application of relatively large load to a-c generators with self-excitation. This has become a serious problem in connection with loads on shipboard. The paper gives very complete curves and discussion of the use of curves to estimate voltage drop and recovery under such operating conditions. There were two discussions on this paper, by G. E. Frost (A '41) General Electric Company, Washington, D. C., and F. V. Smith (M '38) Sargent and Lundy, Chicago, Ill.

The second paper, 42-12, "Steady-State Stability of Synchronous Machines As Affected by Voltage-Regulator Characteristics," by C. Concordia (M 37) General Electric Company, Schenectady, N. Y., deals with the steady-state application of torques to a-c machines and presents very complete formulas on the treatment of such a problem.

"Lighting Protection for Rotating Machines," paper 44-17, by G. D. McCann, Jr. (A '38); E. Beck (M 35); and L. A. Finzi (A '40); all of Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.; discusses a number of different alternate schemes and the relative merits of these when a-c generators directly connected to overhead lines are to be protected, such lines being exposed to lightning surges. These schemes are applicable not only in power generating stations but also in industrial plants where the source of power comes in over exposed lines. This paper was discussed by W. J. Rudge, Jr. (M '39) General Electric Company, Pittsfield, Mass.; E. R. Whitehead (M '39) Duquesne Light Company, Pittsburgh, Pa.; and I. W. Gross (M '40) American Gas and Electric Service Corporation, New York.

The last paper, 44-23, "The Effect of Kilovar Supply on the Design of Systems for Load Growth," by T. W. Schroeder (A '37), J. W. Butler (M '38), and N. H. Meyers (A '41), all of General Electric Company, Schenectady, N. Y., is very timely, since quite often additional kilovar supply will permit existing systems to carry larger loads with very little use of strategic materials. Discussion on this paper was presented by R. G. Hooke (M '28) Public Service Electric and Gas Company, Newark, N. J.; J. G. Holm (M '29), Boston Port of Embarkation (Mass.); and B. M. Jones (F '42) Duquesne Light Company, Pittsburgh, Pa. (*A. C. Monteith, chairman, AIEE committee on power generation.*)

Standards Committee Adopts Two New Standards

Two Standards were approved at the Standards committee meeting of the AIEE winter technical meeting—AIEE Standard 31, "Capacitance Potential Devices and Outdoor Coupling Capacitors," and revision of AIEE Standard 45A, "Modification and Supplement to AIEE Standard 45." Considerable interest is being shown throughout the industry in standardization and simplification of electrical apparatus, and progress was reported concerning several active projects.

A subcommittee of the Standards committee is correlating with the American Society of Mechanical Engineers in the standardization of turbogenerator characteristics in sizes 10,000 kw and above and at this time is giving particular attention to 3,600-rpm units. This group jointly with the power generation committee sponsored a conference during the winter technical meeting and is now formulating tentative recommendations concerning standard electrical characteristics. When this work is completed, the results will be made available to the industry in a joint report with the ASME.

At the present time the wording in various Standards regarding general service conditions is not uniform. Another subcommittee is analyzing the various wordings and correlating them so that uniform terms and phraseology may be available for consideration by the individual technical committees when considering revisions of the various Standards. This group has formulated a tentative set of "Guiding Principles for the Specification of Service Conditions in Electrical Standards."

Work is being carried on actively in the standardization of cable terminal potheads, analyzing the requirements and correlating with the designs which are available. It is expected that this will result in a Standard similar to AIEE Standard 21, "Apparatus Bushings," which was approved in June 1942.

Last year one of the major activities of the Institute was the preparation of wartime Guides and reports. A total of 14 was prepared, and the industry demand for these so exceeded the expectations that for some time the supply of some has been exhausted. One of these, "Industrial Power Distribution Systems," is being reviewed and it is expected that it will be reissued in a few months.

With the advent of new high-temperature insulating materials and the requirements of the aircraft industry for extremely lightweight compact electric equipment, investigations are being conducted to determine temperature limits and ratings suitable to such applications. Conferences have been held, and every attempt is being made to establish conditions and values which ultimately may result in standards. Consideration is being given to sponsoring the formulation of a basic standard test code covering low-frequency impulse and d-c tests. (*J. R. North, chairman, AIEE Standards committee.*)

Safety Committee Outlines Activities for the Year

Outlining his conception of the nature, scope, and possible activities for the coming year of the AIEE committee on safety, W. R. Smith (F '30) chairman, opened the meeting of that committee held during the Institute's 1944 winter technical meeting. In his opinion the committee should be concerned with such subjects as will lead to its recognition as the foremost committee in the field of electrical safety from the technical standpoint.

Discussion of a possible need for the reexamination of the principles behind resuscitation from electric shock was stimulated by presentation of AIEE technical paper 44-22, "Study of Artificial Respiration on Anesthetized Men," by W. B. Kouwenhoven (F '34), D. R. Hooker, and J. A. York, all of The Johns Hopkins University, Baltimore, Md. (*Trans, Jan '44, pp 1–2*). C. F. Engel, assistant medical director, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., pointed out that though there were no unique symptoms attendant on electric shock, it was generally assumed that the effect produced was a paralysis of either the respiratory tract, the diaphragm, or the heart. However, Doctor Engel stated that he has suspected for some time that what actually occurs is similar to an exaggerated faint in that all the blood in the body rushes to the vessels of the abdomen. He said that pressure on the abdomen concomitant to the application of artificial respiration, especially in the pole-top method, may actually revive the victim by forcing the blood back to the vicinity of the heart and hence into circulation.

Several other examples which supported Doctor Engel's contention were supplied by those present. Doctor Kouwenhoven stated that abdominal pressure had been successful in most cases with dogs. E. W. Oesterreich (F '42) superintendent of distribution, Duquesne Light Company, Pittsburgh, Pa., and inaugurator of the pole-top method, mentioned a case in which a victim had been caught behind a bathtub and was revived by abdominal pressure applied in accordance with the pole-top technique. He added that in some cases no resuscitation was necessary when noninjurious falls followed the electric shock. Mr. Smith pointed out that the recognized importance of the time element in reviving victims might indicate that the circulation of the blood must be started rather than respiration alone. He announced the completion of a pamphlet of instructions on the pole-top technique by the accident prevention committee of the Edison Electric Institute. Copies may be obtained by request to the committee on safety or to the Edison Electric Institute, 420 Lexington Avenue, New York, N. Y.

Mr. Smith brought to the attention of the meeting the need for maintaining closer relations with the Student Branches in such things as supplying speakers upon request as well as in bringing the whole question of safety engineering before students. He remarked that engineering graduates appearing in industry were often woefully ignorant of even the rudiments of safety principles. In recommending a paper prepared by C. K. Drinker, professor of physiology, Harvard University, for the National Safety Congress in October 1943, "Evidence Pointing to the Need for a Broader View of Accidents Due to Electricity," Mr. Smith remarked that the seriousness of the low-voltage hazard was not evident in general from mortality statistics alone for the reason that the number of fatalities was not large. He emphasized the importance of efforts being made to give domestic, commercial, and industrial users a better understanding of the fundamentals involved and of the simple precautions that should be taken in the usage and maintenance of equipment, devices, and appurtenances. Mr. Smith announced that the proposal had been made to the committee on domestic and industrial applications that investigation be initiated on the hazards of leakage currents in regard to farm animals. W. B. Buchanan (M '32) Hydro-Electric Power Commission of Ontario, Toronto, head of a group which has already started such investigations, stated that his group was functioning well as a fact-finding body but was experiencing difficulty in applying its data. He added that information already collected indicated that engineering for farms needs more individual attention than has been accorded it heretofore. Although individual losses of animals may seem numerically small, they represent a serious drain in farm economy. He suggested that perhaps the electrical codes need revising in reference to farm wiring where special conditions must be satisfied since the chief danger is to animals.

Mr. Smith called attention to evidences of the need for a better dissemination of authoritative information on the physiological conditions and first aid care of victims of electric shock which could be helpful to ambulance surgeons and other members of the medical profession who are called to attend such victims. Under consideration is the proposal to have an authoritative paper prepared for presentation, through the co-operation of the American Medical Association, at a meeting of that Association and published in its *Journal* and *Electrical Engineering*.

For its future publicity program the committee contemplates the preparation of material for publication in the news columns of *Electrical Engineering* and in this connection hopes to receive suggestions from readers about the type of item which will be most helpful to them. It also desires suggestions on any papers that the committee could sponsor, either directly or jointly with the appropriate technical committee.

Loading and Protection Discussed at Transformer Session

Two papers presented at the session on transformers, January 28, 1944, during the recent AIEE winter technical meeting, were on the subject of overloading and protection of transformers. One paper by W. C. Sealey (M '38) of Milwaukee, Wis., and J. B. Hodtum (M '26) of Pittsburgh, Pa., both with Allis-Chalmers Manufacturing Company, showed means for determining the overload capacity in accordance with the information supplied in previous reports, such as the American Standard *C* 57, "Guide for Operation of Transformers," and the AIEE "Interim Report on Guides for Overloading Transformers and Voltage Regulators" (*AIEE Trans, Sept '42, pp 692–4*). Temperature–time charts were presented, and a method of using them was described. Several of those discussing the paper thought that these curves were in such form that they could be understood easily and would be very useful as a guide in loading transformers.

A paper by V. M. Montsinger (F '29) and G. Camilli (F '43) of the General Electric Company, Pittsfield, Mass., described a new protective arrangement for transformers under overload conditions. This device is arranged to allow for the short-time heavy loads that are permissible as well as the lower loads for long-time intervals. A description was given of the operating principles of the device and also a comparison of the results obtained by this device with the recommendations of the transformer operating guides.

A paper by P. L. Bellaschi (F '40) and Paul Evans, Jr. (A '38) of the Westinghouse Electric and Manufacturing Company, Sharon, Pa., gave the results of research on the effect of altitude on impulse and 60-cycle strength of electrical apparatus. The report covered an extensive investigation under carefully controlled conditions, and the information will be of great value in rating apparatus under high-altitude conditions and in determining the stability of standard apparatus for operation under high-altitude conditions.

The other paper presented at the meeting, "Asymmetrical Loading of Three-Phase Three-Winding Transformer Banks," by P. K. Denissov of the Academy of Science of the Union of Soviet Socialist Republics, described the method of calculating the loading requirements of transformers which would supply single-phase traction load as well as three-phase industrial load. This is seemingly a condition that is encountered in Russia. The most economical transformer installation results when different capacities are provided for the different phases, and this paper shows a method of determining the requirements. (*M. S. Oldacre, chairman, AIEE transformer subcommittee.*)

Teaching Aids at AIEE Meeting for Navy V–12 Training Program

Two special educational sessions at the AIEE winter technical meeting were devoted to aiding the teaching staffs of those engineering colleges throughout the country in which the Navy V–12 specialized training program is being conducted. A representative from each of the colleges so commissioned was invited to attend these co-operative meetings, sponsored jointly by the AIEE committee on education, Robin Beach (F '35) chairman, and the training division of the Bureau of Naval Personnel.

One of these sessions, on Thursday afternoon, January 27, was devoted to an inspection tour through the Brooklyn (N. Y.) Navy Yard. Under the guidance of Navy officers, the specially invited group of 40 electrical engineering teachers examined ships of the destroyer and cruiser class from stem to stern. The compactness and tremendous power of the propulsion machinery was pointed out to them, and they also studied the electrical machinery and control devices.

As a follow-up to the field trip, Captain H. G. Rickover, chief of the electrical section, Bureau of Ships, United States Navy, Washington, D. C., addressed the same group who had inspected the Navy Yard on the previous day at a closed session on Friday morning, January 28. In an informal talk he discussed the subject of most modern design of generating and distributing systems for electric power on shipboard. He explained the manner of segregating and locating generating units, switchboard control centers, and distribution feeders in order to provide maximum reliability in the operation of Naval craft.

Captain Rickover also delivered an address dealing with the subject of electricity on shipboard at an open session Friday evening. He explained the subject of damage to Naval craft from shock resulting from explosions of mines, depth bombs, torpedoes, and aircraft attack. While lecturing he illustrated his explanations with slides of testing machines which have been developed for simulating shock conditions, and by means of which electrical machinery, control units, instruments, and switchboards can be designed now to meet more effectively the rigorous requirements of battle conditions. Another phase of his address treated the subject of rehabilitation of submerged electrical machinery in location. His illustrations showed the dismantling, rewinding, dynamic balancing, and reassembling of large electrical machines in the holds of Navy ships which had been submerged for months. (*Robin Beach, chairman, AIEE committee on Education.*)

Year's Work on Insulating Oils and Cable Saturants Reviewed

A comprehensive report of work done during the past year on the Engineering Foundation–AIEE Research Project on Insulating Oils and Cable Saturants at the Massachusetts Institute of Technology was the subject of a meeting of the AIEE advisory committee and the research workers. The meeting was held in New York on January 27. A brief outline of this project is given in a previous issue (*EE, Jan. '44, p. 38*).

The recent report is of special interest as several problems are covered. Studies have been made on the effect upon the electrical stability of oil of additions such as a number of inhibitors and carbon black. The problem is complex and more work will be necessary, but the results obtained give some interesting insight into the characteristics of oil deterioration.

Investigations covering a temperature range from 85 to 145 degrees centigrade indicated that the effect of temperature upon the electrical stability of oils may be quite different under limited oxidation with relatively small amounts of oxygen from what it is under continuous oxidation with unlimited supply of oxygen.

Because of war conditions, this research project was stopped. The recent report is being distributed to a list of people, and requests for free copies can be made to J. C. Balsbaugh, Massachusetts Institute of Technology, Cambridge, Mass., or to Herman Halperin, Commonwealth Edison Company, 72 West Adams Street, Chicago 90, Ill. (*Herman Halperin, chairman, Engineering Foundation–AIEE Research Project on Insulating Oils and Cable Saturants.*)

W. K. Boice and L. G. Levoy of the General Electric Company, Schenectady, N.Y., with the 400-cycle, a-c aircraft generator which they described at the winter meeting

Major-General Roger B. Colton, who addressed a joint AIEE–IRE evening session of the AIEE winter technical meeting on enemy army communications equipment, is explaining a piece of captured German airborne radio equipment displayed by the Signal Corps during the meeting to two WACS

Colton Describes Enemy Communications Equipment

Enemy army communications equipment was the subject of an address by Major General Roger B. Colton, chief, engineering and technical service, Signal Corps, United States Army, before a joint AIEE–IRE evening session of the AIEE winter technical meeting, January 27, in New York, N. Y.

Indicative of the importance of communications equipment in this war was the general's statement that "the largest annual appropriation for the Signal Service of the Army during World War I was $83,000,000 while during the fiscal year ending June 30, 1943, the appropriation amounted to more than $5,500,000,000—66 times as large." The speaker said that, of the 200 principal items now being delivered to the Signal Corps, 115 of them were developed and standardized since July 1941.

Speaking of enemy army communications equipment, he declared that the German is the best and the Japanese the poorest. The German airborne electrical design is sound but not advanced. The mechanical design, incorporating die castings, and specially designed parts, is of excellent quality, and the cabling is neat. Their equipment is standardized to allow for mass production. In some instances chassis are only partly filled with parts, which indicated that the same chassis is used for other installations. Tubes also have been standardized.

A great deal of the Japanese airborne equipment is obsolete in design and construction from our viewpoint. Wiring in these sets is neatly carried throughout, and a number of points of design resembling American technique have been adapted rather than copied.

German ground components are well built and throughly designed, and all parts are marked with terminal numbers to facilitate easy replacement. Dials are well machined and accurate, and wiring is small and neatly cabled. Japanese ground parts are of obsolete design and in some cases very inferior to American parts. Japanese coil forms are in general very poor. Usually wooden or molded-mud-insulation coils are used. Jap transformers are usually unpotted, and there is no evidence of weatherproofing. Jap crystals and holders are of good design, however, and several Jap holders examined have been very accurately molded, and the crystals accurately ground.

Major General Colton who illustrated his talk by photographic slides of captured enemy equipment stated that this was the first complete discussion of enemy apparatus made public by the Signal Corps.

Special Committee Authorized to Study Employment Conditions

Among the important actions taken by the AIEE board of directors during the recent winter technical meeting was the authorization of a special committee to "study broadly the conditions affecting security of employment and compensation among electrical engineers, with special reference to problems of collective bargaining." The committee is requested to collaborate with a corresponding committee of the American Society of Mechanical Engineers if that society establishes such a committee. Power was given to employ a labor relations adviser, and an appropriation of $1,000 was set aside for the use of the committee. Personnel of the committee has not yet been appointed.

Many engineers, particularly those in industrial plants, have found themselves under pressure to join employees' unions for collective-bargaining purposes. Protestations that they are professional personnel and therefore incorrectly classified with nonprofessional or subprofessional union groups are usually of no avail. The net result has been that many engineers, particularly the younger men entering upon their professional careers in subordinate positions, have been faced with the necessity of either joining unions dominated by nonprofessional people or giving up their employment.

These men have looked to their professional societies for help in this perplexing and trying problem, and one of the Founder Societies, the American Society of Civil Engineers, already has taken positive action by establishing machinery for the organization of collective-bargaining units by its local sections (*EE, Jan '44, p 34*). Formation of such groups, which will be recognized legally as the collective-bargaining agents exclusively for professional engineers, was considered by the society to be the only alternative to bowing before the authority vested in unions of a subprofessional or nonprofessional level. Other societies also are studying the problem to determine what if any action should be taken.

It is expected that the new AIEE committee, after thorough study of all factors involved, will formulate a recommended basic policy that will (1) assist in clarifying the relationship of electrical-engineering personnel to collective-bargaining units and (2) point to any action that can appropriately be taken by AIEE to assist its members who find themselves in this paradoxical situation.

Committee Reports on Voltage Transients in Arc-Furnace Circuits

A progress report by the subcommittee on voltage transients in arc-furnace circuits was submitted orally by E. R. Whitehead (M '39) Duquesne Light Company, Pittsburgh, Pa., at the meeting of the committee on electrochemistry and electrometallurgy, January 27, during the recent AIEE winter technical meeting. This report will be submitted officially after certain changes requested by the subcommittee have been made and will be published as soon as it has been approved. An excellent summary of a considerable number of tests made at different furnace installations and a tabulation of results obtained have been made by the data group of the subcommittee.

According to the report of the subcommittee on dry-type rectifiers, considerable progress already has been made in studying the possibilities of standardizing the nomenclature and symbols used. The report presented by M. F. Skinker (F '34) of International Telephone and Radio Manufacturing Corporation, East Newark, N. J., chairman of the subcommittee, indicated that a great deal more work needs to be done in what is a relatively new field.

Plans for obtaining a number of papers for the next session were discussed. It is expected that papers on induction heating, dry-type rectifiers, and other subjects within the scope of the committee will be obtained. (*C. C. Levy, chairman, AIEE committee on electrochemistry and electrometallurgy.*)

Sections Committee Meets During Winter Technical Meeting

Allocation of unassigned territory in Arkansas to the Memphis–Tulsa and North Texas Sections was approved and recommended to the board of directors at a meeting of the Sections committee January 24 during the recent AIEE winter technical meeting. President N. E. Funk was present for a portion of the meeting and added some excellent ideas to the discussion. Chairman G. W. Bower presided at the meeting which was attended by 22 members.

This assignment of territory in Arkansas completes the allocation of all unassigned territories in the continental United States. The removal of the Midwestern Canada Section from the active list of Sections of the Institute was approved and recommended to the board. This Section has disbanded. The removal of this Section leaves the Provinces of Manitoba, Saskatchewan, and Alberta in District 10 of Canada as unassigned territory.

The delegates' meeting at the AIEE national technical meeting in St. Louis was discussed, and tentative plans provide for a meeting of delegates and also clinics to furnish discussions by the delegates of Section operation and management. This plan is similar to the one used in Cleveland last year with the exception that some novel changes in the program are being planned.

The development of technical groups within the Sections was discussed in detail. Chairman Bower reported the distribution to all Sections of a new folder on technical groups and told of the committee's progress in encouraging the formation of these groups.

Among the other items discussed were:

Development of additional sub-Sections; the plan of a simplified yearly report from each Section chairman on the year's activities of the Section; the plan of sending a Section committee letter during July of each year to the new Section chairman and secretaries, recommending some outstanding features of Section operation and management for their consideration; the use of identification cards or badges at Section meetings; a suggested publicity display during the delegates' meeting at St. Louis; co-operation with the Student Branch and educational committee; a plan of activity on civic affairs; preparation of a proposed manual on Section operation and management.

(*A. C. Muir, secretary, AIEE Sections committee.*)

Lighting Progress and Seeing Discussed at Conference

Recent progress of light sources and the mechanism of seeing were, respectively, the general subjects of two demonstration addresses at the conference on lighting held during the recent AIEE winter technical meeting. W. C. Kalb (F '40) chairman of the AIEE committee on production and application of light, presided.

In the first address, Preston S. Millar (A '03, M '13), president, Electrical Testing Laboratories, Inc., New York, discussed in some detail the improvements achieved in various types of light sources during recent years, demonstrating much of the improved equipment on the platform. His address is scheduled for publication in an early issue.

Declaring that not enough has been said about the reception and utilization of light by seeing organs, S. G. Hibben (A '34), director of applied lighting, Westinghouse Electric and Manufacturing Co., Bloomfield, N. J., pointed out that eyes have evolved as well as the producers of illumination. By a series of slides he showed the structure of the eyes in various levels of animal life, illustrating the evolution to more efficient seeing organs in the higher forms of life. By means of special equipment, he demonstrated the performance of the human eye under various conditions, and also illustrated the effects of defective eyesight. Mr. Hibben's address was supplemented by two motion pictures.

Australian Engineers Exchange Privileges With AIEE

An invitation from the Institution of Engineers, Australia, to AIEE members on service in Australia to accept the privileges of attending meetings, receiving publications, and using the reference libraries of the Institution was accepted by the AIEE board of directors at its meeting January 27. The board voted to extend its thanks for the proffered hospitality and to offer similar privileges to members of the Australian Institution serving in or passing through the United States.

The Institution of Engineers, Australia, which has its headquarters in Sydney, NSW, was founded in 1919 by the amalgamation of various state engineering associations and the Electrical Association of Australia. Divisional headquarters of the Institution exist in the capitals of each of the states of the Commonwealth of Australia as well as in Newcastle, NSW. Regular general meetings at which papers are presented are held by the Institution's divisions.

DISTRICT ● ● ● ● ●

District 10 Executive Committee Meets in Montreal

Membership progress throughout the District and co-operation with the Engineering Institute of Canada and the Canadian Engineers' Council were discussed by members of the executive committee of the Canada District at a meeting held in Montreal, Que., January 17, 1944, at which W. J. Gilson, AIEE vice-president for the District presided.

Mr. Gilson outlined the background and present status of the Canadian Engineers' Council which held an organizational meeting in Montreal, Que., December 11, 1943, with representation from all the engineering bodies in Canada. With organization still in progress, Mr. Gilson proposed to submit a questionnaire to all Canadian AIEE members summarizing the development of the council and aiming at a definition of the members' opinion of the part the AIEE should take in the new council. The AIEE's relationship with the Engineering Institute of Canada in regard to its position and purpose as a national part of an international technical society was discussed at length, but no decision was reached.

An increase in membership was reported by Thomas Ingledow (M '41) for the Vancouver Section and by Frederick Krug (F '36) and D. M. Farnham (M '42) for the Montreal Section. F. C. Barnes (A '30) reported that attendance at meetings of the Toronto Section was well above average.

The Toronto Section reported very successful joint meetings with the Engineering Institute of Canada, the Institute of Radio Engineers, the Meteorological Society, and the Royal Canadian Institute. The Montreal Section has held two well-attended joint meetings.

Future AIEE Meetings

North Eastern District Meeting
Boston, Mass., April 19–20, 1944

Summer Technical Meeting
St. Louis, Mo., June 26–30, 1944

Pacific Coast Technical Meeting
Los Angeles, Calif., Aug. 29–Sept. 1, 1944

In a general discussion of Section procedure Mr. Ingledow recommended a question meeting which has been successfully introduced in the Vancouver Section. Members are asked to submit questions regarding problems on which they desire the opinion of experts, and the meeting is given over to consideration of the questions received. The Toronto Section has designated a committee to investigate the value of the use of badges by the members.

A letter was received by the vice-president from W. P. Dobson (M '19) of the Standards committee requesting that the District executive committee formulate a plan whereby draft standards might be circulated among Canadian AIEE members and their comments collected for the benefit of the Standards committee. As this would involve a classification of the members according to their specializations, it was moved by Mr. Ingledow and seconded by Mr. Farnham that the letter from Mr. Dobson be forwarded to the Sections and suggestions on a feasible course of action collected from them.

SECTION ● ● ● ● ●

Milwaukee Section Membership Shows Steady Increase Since 1939

Contrary to a statement recently appearing in *Electrical Engineering* (Jan. '44, p. 25) the membership of the AIEE Milwaukee Section has not declined. Rather it has increased steadily from 270 members in 1939 to 358 as of November 1943.

The erroneous statement appeared in a report of a meeting of the Great Lakes District executive committee at which membership problems were discussed in detail. The officers were concerned with the difficulties in maintaining the rate of growth established during the last five years in the face of circumstances beyond their control, such as the great flow of members into military service at the present time and the small influx of recent engineering graduates into industry. The committee was anticipating a probable decline in new-membership possibilities rather than reporting and discussing an actual decline in membership enrollment.

PERSONAL ● ● ● ●

Arthur Henry Kehoe (A '12, F '25) vice-president in charge of construction and shops, Consolidated Edison Company of New York (N. Y.), Inc., has been awarded the 1943 Lamme Medal "for pioneer work

R. W. Warner

M. S. Coover

C. A. Powel

A. H. Kehoe

in the development of alternating current networks and associated apparatus for power distribution." Mr. Kehoe was born in Bennington, Vt., February 18, 1889, and was graduated from the University of Vermont with the degree of bachelor of science in electrical engineering in 1911. He has been associated with the Consolidated Edison System Companies since 1911 when he entered the meter department of the United Electric Light and Power Company, New York. From 1914 to 1919 he was distribution engineer and in 1919 became superintendent of the transmission and distribution department. In 1921 he was made electrical engineer and in 1932 was appointed vice-president of the company. At present he is also a member of the board of directors of the New York and Queens Electric Light and Power Company, the New York Steam Corporation, and the Consolidated Telegraph and Electrical Subway Company. Mr. Kehoe served as president of the Edison Electric Institute from 1933 to 1939 and as president of the New York Electrical Society from 1936 to 1938 and is a former member of the board of the National Fire Protection Association. He is a member of Phi Beta Kappa and author of a number of technical papers. Mr. Kehoe has served on many AIEE committees including: electrical machinery, 1924–29; power transmission and distribution, 1924–29; board of examiners, 1927–31; power generation, 1928–29; Standards, 1935–42; and the Lamme Medal, 1937–40; and on the Standards council of the American Standards Association.

C. A. Powel Nominated for AIEE President

Charles Alfred Powel (M '20, F '41) manager, headquarters engineering departments, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been nominated to serve as president of the AIEE for the 1944–45 term. Mr. Powel, who was born July 30, 1884, in Rouen, France, of Welsh parents, was graduated from the Institute of Technology of Canton Bern, Switzerland in 1905 and was naturalized in the United States in 1930. He was employed in the application engineering department of Brown, Boveri and Company, Baden, Switzerland, from 1905 until 1911 when he was sent to Japan as resident engineer for that company. After the outbreak of World War I, he returned to England in 1915 and was connected with the Civil Branch of the British Ordnance Department, first at Woolwich Arsenal, and later in the United States with the British War Mission from 1915 to 1919. In 1919 he joined the Westinghouse company as engineer in the central station section of the general engineering department. He was appointed manager of the central station engineering department in 1935 and manager of the industry engineering department in 1938. He became manager of the headquarters engineering departments in 1940. Among the many AIEE committees of which Mr. Powel has been a member are: power generation, 1933–38; applications to marine work, 1936–40; electric welding, 1937–41; electrochemistry and electrometallurgy, 1939–40; constitution and bylaws, 1940–44; Charles LeGeyt Fortescue Fellowship, 1939–41–43 (chairman 1939–41); Lamme Medal, 1939–42; Standards, 1939–44; education, 1942–44; Edison Medal, 1943–48. He served as AIEE director for 1936–40 and vice-president from the Middle Eastern District (2) for 1942–43. He is the author of a number of papers.

Warner, Coover, Fairman, Henry, and Carpenter Are Nominated for Vice-Presidents

Robert W. Warner (M '28, F '39) professor and head of the department of electrical engineering, University of Texas, Austin, has been nominated AIEE vice-president for the South West District (7). Professor Warner who was born in Freeport, Ill., August 20, 1889, received the degree of bachelor of arts from Washburn College in 1911 and from the University of Kansas the degrees of bachelor of science in electrical engineering in 1918 and of electrical engineer in 1928. In 1918 he was connected with the Ordnance Department of the United States Army and in 1919 was junior engineer with H. L. Doherty and Company, Denver, Colo. From 1919 to 1921 he was assistant to the chief engineer of the Topeka (Kans.) Edison Company. He taught electrical engineering at the University of Kansas, Lawrence, in 1921 and 1922 and at the University of Wisconsin, Madison, in 1922 and 1923. After a period with the General Electric Company, Schenectady, N. Y., as engineer in the switchboard department in 1923 and 1924, he was employed by the Kansas City (Mo.) Power and Light Company as automatic substation engineer. Returning to the University of Kansas in 1928, he was appointed assistant professor of electrical engineering, in 1929 associate professor, and in 1933 professor of electrical engineering. In 1935 he was visiting professor at Massachusetts Institute of Technology, Cambridge, and in 1936 was appointed head of the department of electrical engineering at the University of Kansas. In 1938 he became professor and head of the department of electrical engineering at the University of Texas. His AIEE committee memberships include: the committee on education for 1939–40; and the standards committee for 1941–42. Professor Warner was District secretary for 1930–33; Section chairman for 1933–34 and for 1941–42. In 1934–35 he served as Student Branch Counsellor. He has represented AIEE on a committee of the American Standards Association. He is a member of the Society for the Promotion of Engineering Education.

Mervin S. Coover (A '16, M '32, F '42) professor and head of department of electrical engineering, Iowa State College, Ames, has been nominated AIEE vice-president for the Great Lakes District (5). Professor Coover was born in Shippensburg, Pa., on December 9, 1890, and was graduated from Rensselaer Polytechnic Institute with the degree of electrical engineer in 1914. In 1914 and 1915 he was student engineer with the New York Central Railroad and in 1915 joined the Montana Power Company, Three Forks, as an assistant engineer. In 1917 he was employed by the United Water Power and Light Company, Hutchinson, Kans., as electrician and by the Wilson Grinding Machine Company, Wichita, Kans., as design engineer. After service in the United States Army, he joined the faculty of the University of Colorado, Boulder, as instructor in 1919. He became assistant professor in 1920, associate professor in 1922, and was made professor in 1930. In 1935 he was appointed professor and head of the department of electrical engineering at Iowa State College. Since 1942 he has been assistant regional co-ordinator of the Engineering Science and Management Defense Training program. Professor Coover has outlined courses of instruction in production, transportation, and personnel management and he is the author of a number of articles, pamphlets, and textbooks. He has acted as consultant on special problems for the General Electric Company, the City of Denver, and the Public Service Company of

J. F. Fairman

R. T. Henry

P. L. Alger

C. B. Carpenter

Colorado. He was a member of the AIEE board of directors from 1940 to 1944 and has served on the following committees: automatic stations, 1927–29; Sections, 1937–43 (chairman 1940–42); education 1937–43; research, 1937–40; planning and co-ordination, 1940–42; and the Edison Medal, 1941–43. He was District secretary from 1929 to 1931. In 1938 he received the John Dunlap Memorial award of the Iowa Engineering Society of which he is a member. He is also a member of the Society for the Promotion of Engineering Education, Tau Beta Pi, Eta Kappa Nu, and Sigma Tau.

Charles Benjamin Carpenter (A '23, M '34) assistant chief engineer, general engineering department, Pacific Telephone and Telegraph Company, Portland, Oreg., has been nominated for AIEE vice-president for the North West District (9). Born in Urbana, Ill., October 27, 1900, Mr. Carpenter was graduated from the State College of Washington with the degree of bachelor of science in electrical engineering in 1922 and from Stanford University with the degree of electrical engineer in 1923. He was employed as electrical draftsman by the Portland (Oreg.) Electric Power Company from 1923 to 1926. Entering the employ of the Washington Water Power Company, Spokane, in 1926, he was assistant to the engineer in charge of electrical design of the Chelan Power Project, and field electrical engineer until in 1929 he joined the Pacific Telephone and Telegraph Company, Seattle, as engineer in the chief engineer's department. After a few months in 1933 as technical man for the Home Telephone and Telegraph Company, Spokane, he was placed on the staff of the outside plant and transmission engineering department for the Oregon area of the Pacific Telephone and Telegraph Company. In 1941 he was appointed assistant chief engineer. Mr. Carpenter served on the AIEE committee on communications for 1938–41. He was Section secretary for 1931–32 and for 1937–38, and chairman for 1938–39. He was vice-president of the Professional Engineers of Oregon in 1941. He is a member of Tau Beta Pi, Sigma Tau, and Sigma Xi.

James Ferdinand Fairman (A '20, M '27, F '35) assistant vice-president, Consolidated Edison Company of New York (N. Y.), Inc., has been nominated AIEE vice-president for the New York City District (3). Born in Big Rapids, Mich., April 8, 1896, Mr. Fairman received from the University of Michigan the degrees of bachelor of science in electrical engineering in 1918 and master of science in 1921. After taking the graduate student course at the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., he continued at the University of Michigan, Ann Arbor, as instructor in electrical engineering from 1919 to 1922, and in 1922 was made assistant professor. In 1925 he joined the Brooklyn (N. Y.) Edison Company as assistant outside plant engineer and was made outside plant engineer and assistant electrical engineer in 1926 and electrical engineer in 1932. In 1937 he became electrical engineer for the Consolidated Edison Company and in 1941 was appointed assistant vice-president for design, inventory, purchasing, and stores. Mr. Fairman has served on many AIEE committees including: safety codes, 1931–34; general power applications, 1934–36; electrical machinery, 1936–37; the board of examiners, 1941–43; and the committee on education, 1941–42. Since 1938 he has been an AIEE representative on the Engineers' Council for Professional Development. He has been active in Section affairs, holding the Section offices of secretary for 1937–38 and chairman for 1940–41; as well as that of District secretary for 1937–38. Mr. Fairman served on the electrical equipment committee of the Edison Electric Institute and is president of the New York State Society of Professional Engineers. He is a member of Sigma Xi, Tau Beta Pi, and is a trustee of the Flatbush Savings Bank.

Raymond T. Henry (A '24, M '29, F '33) assistant chief electrical engineer, engineering department, Buffalo (N. Y.), Niagara and Eastern Power Company, has been nominated for AIEE vice-president for the North Eastern District (1). He was born November 17, 1889, in Stronghurst, Ill. In 1907 he attended the engineering school of the General Electric Company, Lynn, Mass., and in 1908 was employed as a draftsman by that company. As a draftsman he entered the employ of the Niagara Falls (N. Y.) Hydraulic Power and Manufacturing Company in 1909. He worked for the Hooker Electrochemical Company, Niagara Falls, as assistant electrical engineer in 1912 and for the Edison Illuminating Company, Detroit, Mich., in 1913. From 1914 to 1918 he was assistant superintendent in the Niagara Electric Service Corporation, Niagara Falls. Joining the Niagara Falls Power Company in 1918 as assistant electrical engineer, he became electrical engineer in charge of design in 1929 for the Buffalo, Niagara and Eastern Power Corporation, when the latter absorbed the Niagara Falls Power Company. Mr. Henry was awarded the AIEE national prize for the best paper in engineering practice for 1934 as co-author of the paper, "Fundamentals of Design of Electrical Energy Delivery Systems." He served as chairman of the Niagara Frontier Section for 1929–30. His other AIEE activities include membership on the protective devices committee for 1931–34 and for 1939–43 (chairman 1932–34); the standards committee, 1936–43 (chairman 1940–42); the committee on planning and co-ordination, 1940–42; and current service as AIEE representative on the Standards Council of the American Standards Association for 1941–43. He has been chairman of the Edison Electric Institute committee on electrical equipment for 1942–44. Mr. Henry was a member of the National Electrical Manufacturers Association's joint committee on oil circuit breakers.

Alger, McHenry, Quarles, Nominated for Directorships

Philip Langdon Alger (A '17, M '22, F '30) assistant to the vice-president in charge of design, has been nominated to serve on the AIEE board of directors. Born in Washington, D. C., January 27, 1894, Mr. Alger received the degree of bachelor of science from St. John's College in 1912 and from Massachusetts Institute of Technology in 1915. In 1920 he received the degree of master of science from Union College. He was laboratory assistant at Massachusetts Institute of Technology from 1915 until he entered the United States Army. In 1919 he was employed by the General Electric Company, Schenectady, N. Y., in the induction-motor engineering department and in 1923 was transferred to the a-c engineering department of which he was made assistant engineer in 1927. He was appointed assistant to the vice-president in 1929. He has served on the following AIEE committees: electrical machinery, 1926–32 (chairman 1929–32) and in 1942; Lamme Medal, 1932–35; Standards, 1932, 1942–44; planning and co-ordination, 1941–43; technical program, 1941–44 (chairman 1941–43). Mr. Alger is the author of several technical papers and a member of the American Society of Mechanical Engineers, the American Mathematical Society, the Army Ordnance Association, the Society

M. J. McHenry

for the Promotion of Engineering Education, the American Association for the Advancement of Science, the Reserve Officers Association, the Newcomen Society, the American Legion, and the National Municipal League. In 1938 he was one of the United States delegates to the plenary meeting of the International Electrotechnical Commission at Torquay, England.

Morris James McHenry (A '11, M '20) director of sales promotion, Hydro-Electric Power Commission, Toronto, Ont., has been nominated to serve on the AIEE board of directors. Born in Catasauqua, Pa., August 8, 1888, he was graduated from McGill University with the degree of bachelor of science in 1910. From 1910 to 1912 he was engaged in the design of hydroelectric power stations with Smith, Kerry, and Chase, Consulting Engineers, Toronto. He joined the Canadian General Electric Company, Toronto, as sales engineer in 1912 and became assistant manager of the Toronto district office in 1916. From 1918 to 1924 he was manager and secretary-treasurer of the Walkerville (Ont.) Hydro-Electric System. He was made manager of the Ferranti Electric Company, Ltd., Toronto, in 1924 and manager of the United States sales department of the Canadian General Electric Company in 1926. In 1930 he was appointed district manager for Ontario, and in 1938 director of sales promotion for the Hydro-Electric Power Commission. He served as vice-president of the Institute for 1937–38 and has been a member of the committee on general power applications, 1920–22, 1937–38; and the committee on industrial power applications, 1938–43. Mr. McHenry is the 1943–44 chairman of the committee on transfers of which he has been a member since 1941. He was chairman of the Toronto Section for 1935–36. He is a member of the Association of Professional Engineers of Ontario, the Electric Club of Toronto, and the Electric Service League of Toronto.

Donald Aubry Quarles (A '23, M '29, F '41) director of transmission development, Bell Telephone Laboratories, Inc., New York, N. Y., has been nominated to serve on the AIEE board of directors. Mr. Quarles was born July 30, 1894, in Van Buren, Ark., and was graduated from Yale University with the degree of bachelor of arts in 1916. He served as captain in the United States Army during World War I and in 1919 entered the engineering department of the Western Electric Company, New York. When this department was incorporated into Bell Laboratories in 1925 he continued with the new organization. From 1919 to 1924 he worked as engineer and supervisor on transmission engineering research and in 1924 was made apparatus inspection engineer. Transferred to the outside plant development department, he was named plant system engineer in 1928 and was put in charge of the department as assistant director of apparatus development in 1929. In 1935 he was titled outside plant development director and in 1940 became director of transmission development. Mr. Quarles served as secretary of the New York Section for 1939–40 and as Section chairman for 1941–42. He is a member of the American Physical Society, Phi Beta Kappa, and Sigma Xi.

D. A. Quarles

W. I. Slichter Renominated for AIEE Treasurer

W. I. Slichter (A '00, M '03, F '12) professor emeritus of electrical engineering, Columbia University, New York, N. Y., has been renominated for the office of AIEE treasurer which he has held since 1930. Professor Slichter was born in St. Paul, Minn, May 7, 1873, and was graduated from Columbia University with the degree of electrical engineer in 1896. While he was associated with the General Electric Company, Schenectady, N. Y., from 1897 to 1904, he spent five years as assistant to C. P. Steinmetz on a-c machinery design. In 1910 he was appointed professor and head of the department of electrical engineering at Columbia University and has been professor emeritus since 1941. At present he represents AIEE on the board of the Engineering Library and on the Engineering Foundation board. Recently he served on the AIEE committee on Inter-American Engineering Co-operation and as AIEE representative on the joint committee on Inter-American Engineering Co-operation. He was chairman of the special committee on pension plans from 1937 to 1943.

E. H. Bailey (A '18, M '40) district transformer specialist, General Electric Company, Atlanta, Ga., recently was elected president of the Georgia Engineering Society. Mr. Bailey was chairman of the Georgia Section of AIEE for 1940–41.

OBITUARY • • • •

Richard C. Engelken (M '33) partner, Hamel and Engelken, New York, N. Y., died January 19, 1944. Mr. Engelken was born in New York, December 9, 1903, and was graduated from Cooper Union with the degree of bachelor of science in electrical engineering in 1926. He was first employed as an electrician's apprentice by Oberg, Blumberg and Bleyer, contracting engineers, New York, N. Y., in 1918 and 1919 and by the Universal Electric Stage Lighting Company, New York, from 1919 to 1922. In 1922 he entered the employ of the Electrical and Mechanical Service Company, New York, as electrical machinist and in 1924 he became engineering assistant in the distribution system of the Brooklyn (N. Y.) Edison Company with which he remained until 1928. He returned to the Universal Electric Stage Lighting Company, Inc., from 1928 to 1936 and during this time had charge of the engineering connected with the manufacture of arc and incandescent lighting equipment. In 1936 he joined the firm of Morgan, Hamel, and Engelken, New York, which became Hamel and Engelken in 1941. Recently as a representative of the Vitarama Corporation, Long Island City, N. Y., he had traveled widely for the War Department supervising the installation of antiaircraft gunnery equipment. In this connection he had toured the Pacific war area. Mr. Engelken designed many of the lighting effects at the New York World's Fair, the Hayden Planetarium, the Museum of Natural History and many New York night clubs and restaurants and installed the lighting systems at the Radio City Music Hall.

Edward Bedell Snyder (A '17, M '25) retired engineer, Charleston, W. Va., died December 17, 1943. Born in Charleston, December 5, 1881, Mr. Snyder received from Center College the degrees of bachelor of science in 1903 and master of arts in 1904. In 1903 and 1904 he was a member of the physics department faculty and in 1904 joined the Charleston Electric Supply Company where he worked on sales engineering matters connected with mining work. He commenced his 25-year association with the Ohio Brass Company in 1906 as head of the sales mining department, Mansfield, Ohio. In 1910 he was transferred to the high-tension insulator department and made manager of sales and commercial engineering. After a short period in 1920–21 as secretary and assistant manager of the Ohio Insulator Company, subsidiary of the Ohio Brass Company at Barberton, Ohio, he returned to his former position at Mansfield. In 1927 he was reappointed secretary of the Ohio Insulator Company, Barberton. Retiring in 1932 he practiced as a consultant until 1935 when he became assistant manager of the First Central Trust Company, Barberton. In 1939 he retired to Charleston. Mr. Snyder did much original research in connection with oils for insulators. He was instrumental in forming the West Virginia Section of the AIEE and served as its first chairman, 1940–41.

Arnold James Magley (A '24) chief engineer, Moloney Electric Company of Canada, Ltd., Toronto, died December 22, 1943. He was born in Columbia City, Ind., November 27, 1891, and was graduated from Purdue University with the degree of bachelor of science in 1914. Joining the General Electric Company, Fort Wayne, Ind., as student apprentice in 1914 he later worked on general transformer design and drafting. In 1916 he entered the employ of the Moloney Electric Company, St. Louis, Mo., as transformer designer and after 1917 when he was transferred to Windsor, Ont., he added factory management to his duties. The Moloney factory was moved to Toronto in 1922 and Mr. Magley was appointed chief engineer.

MEMBERSHIP • •

Recommended for Transfer

The board of examiners at its meeting on February 17, 1944, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Fellow

Dibblee, John, asst. chief engr., Hydroelectric Power Commission, Toronto, Ont., Canada.
Hapgood, K. E., chief power engg. & Design div., Tennessee Valley Authority, Chattanooga, Tenn.
Terwilliger, C. V. O., prof. and head of elec. engg. dept., U. S. Naval Academy, Annapolis, Md.
Turner, H. M., associate professor, Yale University, New Haven, Conn.

4 to grade of Fellow

To Grade of Member

Ballantyne, W. M. H., inspection engr., Pennsylvania Water & Power Co., Baltimore, Md.
Ballard, W. C., prof. of elec. engg., Cornell Univ., Ithaca, N. Y.
Bronwell, A. B., associate prof. of elec. engg., Northwestern University, Evanston, Ill.
Chambers, C. C., associate prof. of elec. engg., University of Pennsylvania, Philadelphia, Pa.
Cox, V. L., assistant engr., General Elec. Co., Philadelphia, Pa.
Davison, A. E., transmission engr., Hydroelectric Power Comm. of Ontario, Toronto, Ont., Canada.
Graham, C. H., principal electrical engr., Puerto Rico Water Resources Authority, Santurca, P. R.
Grotzinger, John, mgr., elec. engg. div., Goodyear Tire & Rubber Co., Akron, Ohio.
Haase, H. W., testing engr., Kyle Corp., So. Milwaukee, Wis.
Harvey, H. F., elec. engr., Newport News Shipbuilding & Dry Dock Co., Newport News, Va.
Koso, K. W., elec. maintenance foreman, Kansas City Pwr. & Lt. Co., Kansas City, Mo.
Kyle, W. D., president, Kyle Corp., So. Milwaukee, Wis.
LePage, W. R., asst. director, Johns Hopkins Univ., Baltimore, Md.
Lowe, R. E., central station dept., General Electric Co., Newark, N. J.
McCurley, J. B., Lt. Comdr., U. S. Navy Dept., Annapolis, Md.
McGill, C. W., division head, Boston Edison Co., Boston, Mass.
McMillan, W. R., system supt., Union Electric Co. of Missouri, St. Louis, Mo.
Milne, F. J., toll engr., Bell Telephone Co. of Canada, Toronto, Ont., Canada.
Osenbaugh, C. L., elec. distribution engr., Memphis Light, Gas & Water Div., Memphis, Tenn.
Petzinger, A. J., design engr., Westinghouse Elec. & Mfg. Co., Newark, N. J.
Rhodes, H. A., elec. engr., Humble Pipe Line Co., Houston, Texas.
Royal, A. B., design engr., The Louis Allis Co., Milwaukee, Wis.
Ryan, E. C., chief inspector, The Ohio Brass Co., Mansfield, Ohio.
Savage, P. R., mgr., Woodbury Telephone Co., Woodbury, Conn.
Tebo, G. B., supervising engr., Hydroelectric Power Comm. Laboratories, Toronto, Ont., Canada.
Velander, Edy, Director, Royal Swedish Institute of Scientific Engg. Research; present address, Washington, D. C.
Wolfe, A. K., District Mgr., Allen Bradley Co., Milwaukee, Wis.
Woth, T. J., central station engr., Westinghouse Elec. & Mfg. Co., Atlanta, Ga.
Yost, N. S., chief engr., Howell Electric Motors Co., Howell, Mich.

29 to grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Names of applicants in the United States and Canada are arranged by geographical District. Any member objecting to the election of any of these candidates should so inform the national secretary before March 31, 1944, or May 31, 1944, if the applicant resides outside of the United States or Canada.

To Grade of Member

Bredahl, A. C. (Re-election), Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
Brewster, T. P., A. T. & S. F. Ry. Co., Chicago, Ill.
Butterworth, J. W., Federal Tel. & Radio Corp., Newark, N. J.
Cage, J. M., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Caller, J. M., Sperry Gyroscope Co., Brooklyn, N. Y.
Chandler, F. E., Wisconsin Tel. Co., Milwaukee, Wis.
Chen, L. F., National Resources, Commission of China, New York, N. Y.
Dallas, J. P., Hughes Aircraft Co., Culver City, Calif.
Freeman, R. C., General Elec. Co., West Lynn, Mass.
Gardner, R. H. (Re-election), Hoover Co., North Canton, Ohio.
Hagen, E. F., American Tel. & Tel. Co., Denver, Colo.
Hall, A. C., Mass. Inst. of Tech., Cambridge, Mass.
Higdon, J. J., Rural Electrification Adm., St. Louis, Mo.
Hufnagel, H. M., Rust Engg. Co., Pittsburgh, Pa.
Littler, R. G. (Re-election), Kaiser Co., Inc., Portland, Oreg.
Lohse, A., Permanente Metals Corp., Palo Alto, Calif.
Long, T., C. G. Conn, Ltd., Elkhart, Ind.
MacLaren, D. B., U. S. War Dept., Fort Mason, Calif.
McWilliams, J. L., Rural Electrification Adm., St. Louis, Mo.
Moffett, G. A., General Elec. Co., Schenectady, N. Y.
Morton, R. C., Harvard Underwater Sound Lab., Cambridge, Mass.
Moyer, E. E., General Elec. Co., Schenectady, N. Y.
Phair, H. W., Fairchild Aviation Corp., New York, N. Y.
Ross, I. E., Jr., Natl. Elec. Mfgrs. Assn., New York, N. Y.
Slater, S. I. (Re-election), Slater Elec. & Mfg. Co., Brooklyn, N. Y.
Thompson, D. B. (Re-election), N. Y. C. System, New York, N. Y.
Tucker, A. N., Mallory Metallurgical Products, Ltd., London, England.
Waite, R. (Re-election), Otis Elev. Co., New York, N. Y.
Whittle, H. A., Rural Electrification Adm., St. Louis, Mo.
Wrigley, W. G., Elec. Construction Co., Ltd., Bushbury, England.

30 to grade of Member

To Grade of Associate

United States and Canada

1. North Eastern

Bonner, H. M., Eastman Kodak Co., Rochester, N. Y.
Burpee, W. E., E. B. Badger & Sons, Co., Boston, Mass.
Byers, W. F., General Radio Co., Cambridge, Mass.
Chamberlain, J. E., General Elec. Co., Schenectady, N. Y.
Chun, C. J., General Elec. Co., Pittsfield, Mass.
Clark, D. L., Stromberg-Carlson Co., Rochester, N. Y.
Crowe, T. W. A., Jr., General Elec. Co., Schenectady, N. Y.
Crumb, S. F., General Elec. Co., Schenectady, N. Y.
Day, C. M., New England Tel. & Tel. Co., Boston, Mass.
Delaney, B. W., Public Serv. Co. of N. H., Manchester, N. H.
Donahue, B. L., Cutler-Hammer, Inc., Buffalo, N. Y.
Euler, G. M., General Elec. Co., Schenectady, N. Y.
Ewaskio, C. A., Harvard Underwater Sound Lab., Cambridge, Mass.
Fano, R., Mass. Inst. of Tech., Cambridge, Mass.
Griggs, R. E., General Elec. Co., Schenectady, N. Y.
Grosse, P. C., Mass. Inst. Tech., Cambridge, Mass.
Hadley, N. L., General Elec. Co., Schenectady, N. Y.
Hamm, N. G., Mass. Inst. of Tech., Cambridge, Mass.
Hartman, R. L., General Elec. Co., Schenectady, N. Y.
Henkel, R. L., Harvard Univ., Cambridge, Mass.
Iffland, J. J., Harvard Univ., Cambridge, Mass.
Johnson, J. O., Jr., Westinghouse Elec. & Mfg. Co., Boston, Mass.
Jones, D. W., Jr., General Elec. Co., Schenectady, N. Y.
Judd, H. R., Lieut. U.S.N.R., New London, Conn.
Kaisel, S. F., Harvard Univ., Cambridge, Mass.
Kearney, J. W., Harvard University, Cambridge, Mass.
Keller, E. W., Mass. Inst. Tech., Cambridge, Mass.
Ketcham, A. W., Ensign, U.S.N.V., Salisbury, Vt.
Lane, J. D., Harvard Univ., Cambridge, Mass.
Langenwalter, D. F., Cornell Univ., Ithaca, N. Y.
Larew, J. J., General Elec. Co., Schenectady, N. Y.
MacKay, R. F., Worcester Poly. Inst., Worcester, Mass.
Maguire, L. N., 101 Hope St., Stamford, Conn.
Matson, W. E., General Elec. Co., Schenectady, N. Y.
Morrison, W. C., General Electric Co., Schenectady, N. Y.
Reeves, J. F., Mass. Inst. of Tech., Cambridge, Mass.
Rhoades, C. M., Jr. (Re-election), General Elec. Co., Schenectady, N. Y.
Riley, J. C., Harvard Univ., Cambridge, Mass.
Rivest, E. L., General Electric Co., Syracuse, N. Y.
Sargent, D. M., Mass. Inst. of Tech., Cambridge, Mass.
Tallman, W. C., Mass. Inst. Tech., Cambridge, Mass.
Tucker, A. S., General Elec. Co., Lynn, Mass.
Wane, H. T., Westinghouse Elec. & Mfg. Co., Springfield, Mass.
Wedel, J. J., Jr., Harvard Univ., Cambridge, Mass.
White, E. C., General Elec. Co., Schenectady, N. Y.
Wright, H. E. A., Westinghouse Elec. & Mfg. Co., Boston, Mass.
Wulfetange, J. F., Jr., Schiefer Electric Co., Syracuse, N. Y.
Wulfken, H. J., General Elec. Co., Schenectady, N. Y.
Zeller, H. R., Mass. Inst. Tech., Cambridge, Mass.

2. Middle Eastern

Ashton, W. J., Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
Begis, M. J., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Bissett, E. B., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Bonham, L. L., Naval Research Lab., Washington, D. C.
Booth, W. S., Ensign, U.S.N.R., Washington, D. C.
Bradley, J. M., Cincinnati Gas & Elec. Co., Cincinnati, Ohio.
Busse, C. C., Pvt., U. S. Army, Pittsburgh, Pa.
Colberg, J. C., Naval Research Lab., Washington, D. C.
Conway, J. G., 6930 Greenwood St., Pittsburgh, Pa.
Cook, M. E., Naval Research Lab., Washington, D. C.
Crane, A. H., Jr., Naval Research Lab., Washington, D. C.
Cuttino, W. H., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Davidson, F. A., U. S. Engineers, Cincinnati, Ohio.
Davis, J. D. L., Westinghouse Elec. & Mfg. Co., Lima, Ohio.
Davis, R. T., U. S. Navy, Washington, D. C.
DeByle, W. C., Naval Research Lab., Washington, D. C.
Descalzi, R., General Elec. Co., Philadelphia, Pa.
Dykstra, G. G., General Elec. Co., Erie, Pa.
Emory, J. C., G. L. Martin Co., Middle River, Md.
Estrin, M., N.A.C.A., Cleveland Airport, Cleveland, Ohio
Field, E. J., Roller-Smith Co., Bethlehem, Pa.
Fishman, M., Carnegie Inst. of Tech., Pittsburgh, Pa.
Galbreath, D. H., General Elec. Co., Erie, Pa.
Gelinas, R. W., Westinghouse Elec. & Mfg. Co., Baltimore, Md.
Giusti, V. F., Lieut. U.S.N.R., Piqua, Ohio.
Goldston, A. C., I.T.E. Circuit Breaker Co., Philadelphia, Pa.
Goodell, C. E., Jr., Naval Ordnance Lab., Washington, D. C.
Gould, I. J. (Re-election), Bureau of Ships, Washington, D. C.
Graham, R. E., Sylvania Elec. Prods., Inc., Emporium, Pa.
Griffith, C. (Re-election), E. G. Budd Mfg. Co., Philadelphia, Pa.
Guyton, W. J., Allis-Chalmers Mfg. Co., Washington, D. C.
Hartmann, W. A., Jr., Naval Research Lab., Washington, D. C.
Heisler, D. E., Naval Research Lab., Washington, D. C.
Herbert, L. G., Johns Hopkins Univ., Silver Spring, Md.
Hermach, F. L., National Bur. of Standards, Washington, D. C.
Humphrey, J. T., Westinghouse Elec. Co., East Pittsburgh, Pa.
Hutchinson, C. E., Heinemann Circuit Breaker Co., Trenton, N. J.
Kletzel, G. W., Philco Corp., Philadelphia, Pa.
Knox, G. W., Westinghouse Elec. & Mfg. Co., Baltimore, Md.
Levin, M. J., Cincinnati Gas & Elec. Co., Cincinnati, Ohio.
Lynch, D. R., Westinghouse Elec. & Mfg. Co., Fairmont, W. Va.
Mason, M. F., Ohio Public Serv. Co., Elyria, Ohio.
McDonald, F. E., U. S. Engineers, Cincinnati, Ohio.
McHarg, C. A., Bureau of Ships, Washington, D. C.
McPherson, G., Jr., Naval Research Lab., Washington, D. C.
Merriam, F. R., N.A.C.A., Cleveland Airport, Cleveland, Ohio.
Midyett, W. M., Lieut., U. S. Army, Fort Dix, N. J.
Miley, A. M., Elec. Storage Battery Co., Philadelphia, Pa.
Mohan, J. T., Jr., American Tel. & Tel. Co., Cincinnati, Ohio.
Naidamast, D., Philco Radio & Tel. Corp., Philadelphia, Pa.
Payson, E. C., Lieut., U. S. Army, Aberdeen Proving Ground, Md.
Renoff, G. F., Johns Hopkins Univ., Baltimore, Md.
Rexford, D. L., I.B.M. Corp., Toledo, Ohio.
Rice, C. T., Princeton University, Princeton, N. J.
Salzman, C. F., State College, Pa.
Sanborn, C. B., Jr., Naval Research Lab., Washington, D. C.
Schey, S. L., Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa.
Schneider, C. A., Univ. of Cincinnati, Cincinnati, Ohio.
Schulz, R. B., Univ. of Penna., Philadelphia, Pa.
Sharpless, T. K., University of Penna., Philadelphia, Pa.
Sherertz, P. C., Ensign, U.S.N.R., Washington, D. C.
Stoner, R. H., Goodyear Aircraft Corp., Akron, Ohio.
Taylor, A. D., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Tolbert, J. W., Allis-Chalmers Mfg. Co., Washington, D. C.
Trasatti, R. J., I-T-E Circuit Breaker Co., Philadelphia, Pa.
Unger, J. W., Princeton Univ., Princeton, N. J.
Watson, H. M., Westinghouse Elec. & Mfg., East Pittsburgh, Pa.
Weller, E. F., Jr., 2nd Lieut., U. S. Army, Charleston, W. Va.
Woods, T. J., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Woomer, K. E., Phila. Navy Yard, Philadelphia, Pa.
Worman, T. H., Island Creek Coal Co., Holden, W. Va.

3. New York City

Allen, H. B. (Re-election), New Jersey Pwr. & Lt. Co., Dover, N. J.
Allerton, G. L., Western Elec. Co., New York, N. Y.
Anselmi, R. F., Todd Shipyard Corp., Hoboken, N. J.
Atkins, J. W., Sperry Gyroscope Co., Garden City, N. Y.
Banks, J. H., Syncro Mach. Co., Rahway, N. J.
Barnett, G. F., Johns-Manville Research Lab., Manville, N. J.

Berkovitz, H., Westinghouse Elec. Elevator Co., Jersey City, N. J.
Brechman, G. E., New York Univ., New York, N. Y.
Bloser, E. C., Sperry Gyroscope Co., Garden City, N. Y.
Bfeckman, J. N., Western Electric Co., Kearny, N. J.
Bridge, J. A., Federal Tel. & Radio Corp., East Newark, N. J.
Bright, H. S., Western Elect. Co., New York, N. Y.
Carter, J. C., Signal Corps, Camp Evans, N. J.
Colehower, C. H., Jr., Norden Labs. Corp., New York, N. Y.
Contrast, G. A., Sperry Gyroscope Co., Garden City, N. Y.
Covello, F. S., Ward Leopard Elec. Co., Mount Vernon, N. Y.
DelValle, P. B., Ford Instrument Co., Long Island City, N. Y.
DePass, E. T., Ensign, U.S.N.R., New York, N. Y.
Dewey, W. S., New York Tel. Co., New York, N. Y.
DiSarro, B., U. S. Navy Yard, Brooklyn, N. Y.
Drvostep, J. J., Sperry Gyroscope Co., Brooklyn, N. Y.
Dunn, R. F., R. C. A. Victor Div. of R. C. A., Harrison, N. J.
Echtman, L., School of Technology, C. C. N. Y., New York, N. Y.
Gault, W. E., R. C. A. Mfg. Co., Harrison, N. J.
Gentile, S. P., Western Elec. Co., Inc., Jersey City, N. J.
Getchell, W. A., Jr., Bell Tel. Lab., Inc., New York, N. Y.
Goodstein, L. D., Sperry Gyroscope Co., Garden City, N. Y.
Grove, A. W. (Re-election), H. Behlen & Bros., Inc., New York, N. Y.
Gulack, J. G., Federal Tel. & Radio Labs., New York, N. Y.
Guyonnet, M., Jr., Western Elec. Co., Kearny, N. J.
Hewson, K. D., R. C. A. Mfg. Co., Harrison, N. J.
James, W. S., Ward Leonard Elec. Co., Mount Vernon, N. Y.
Kahal, R., Sperry Gyroscope Co., Garden City, N. Y.
Lane, R. N., Gibbs & Hill, Inc., New York, N. Y.
Lang, P., Norden Labs. Corp., New York, N. Y.
Laster, N. D., Ensign, U.S.N.V., New York, N. Y.
Ledwith, C., F. R. Harris, Inc., New York, N. Y.
Leef, G. R., Federal Tel. & Radio Corp., Newark, N. J.
Martin, S. J., Radio Televisions Inst., New York, N. Y.
McKay, J. R., Sperry Gyroscope Co., Garden City, N. Y.
Oster, H. A., New Jersey Bell Tel. Co., Newark, N. J.
Peterson, D. H., U. S. Navy Yard, Brooklyn, N. Y.
Powell, A. E., Federal Tel. & Radio Corp., Newark, N. J.
Ralston, R. R., P. J. Schweitzer, Inc., Spotswood, N. J.
Reeder, W. F., New Jersey Bell Tel. Co., Newark, N. J.
Schreiber, C. R., Curtiss-Wright Corp., Caldwell, N. J.
Schwartz, R. J., Columbia Univ., New York, N. Y.
Seppanen, M. T., Sperry Gyroscope Co., Brooklyn, N. Y.
Smith, D. H., Bendix Aviation Corp., New York, N. Y.
Steiny, J., Federal Tel. & Radio Corp., Newark, N. J.
Stiner, M., Otis Elevator Co., Yonkers, N. Y.
Taylor, G. J., General Elec. Co., New York, N. Y.
Weiss, G., Liquidometer Corp., New York, N. Y.
Wiese, D. B., Westinghouse Elec. & Mfg. Co., Newark, N. J.
Wildken, H. J., Electrical Testing Labs., Inc., New York, N. Y.
Williamson, T. L. R., Pratt Institute, Brooklyn, N. Y.
Wolff, J. E., Emerson Radio Corp., New York, N. Y.
Ziegler, J. R., Norden Labs. Corp., New York, N. Y.

4. Southern

Alexander, F. C., General Elec. Co., Columbia, S. C.
Atkinson, C. A., Memphis Light, Gas & Water Div., Memphis, Tenn.
Brittain, J. B., Charleston Navy Yard, Charleston, S. C.
Brown, W. L., Tenn. Eastman Corp., Oak Ridge, Tenn.
Cheatham, R. E., Jr., Miss. Pwr. & Lt. Co., Jackson, Miss.
Farmer, A. L., Higgins Aircraft, New Orleans, La.
Googe, W. J., Southwestern Gas & Elec. Co., Shreveport, La.
Hayley, A. L., Jr., Louisville Gas & Elec. Co., Louisville, Ky.
Horning, R. B., General Elec. Co., Charlotte, N. C.
Kitchen, A. N., Jr., Tenn. Eastman Corp., Oak Ridge, Tenn.
Koutnik, E. A. (Re-election), Tenn. Eastman Corp., Oak Ridge, Tenn.
Lough, J., Holophane Co., Inc., Atlanta, Ga.
Means, C. P., Jr., U. S. Navy Yard, S. C.
Parker, J. E., Carbide & Carb. Chem. Corp., Louisville, Ky.
Pendray, T., Tenn. Valley Auth., Chattanooga, Tenn.
Roberts, C. A., Tenn. Valley Auth., Chattanooga, Tenn.
Senn, T. A., Jr., Norfolk Navy Yard, Portsmouth, Va.
Smith, H. T., Girdler Corp., Louisville, Ky.
Treis, J. P., Knoxville Elec. Pwr. & Water Bd., Knoxville, Tenn.
Votava, Y., Tenn. Valley Auth., Wilson Dam, Ala.

5. Great Lakes

Adler, G. H., Public Serv. Co. of N. Ill., Maywood, Ill.
Bankson, H. D., Line Material Co., South Milwaukee, Wis.
Bellinger, T. F., Allis-Chalmers Co., Milwaukee, Wis.
Chadkewicz, A., Chrysler Corp., Detroit, Mich.
Clark, F. J., U. S. Army, Muncie, Ind.
Frontjes, M., A.-C. Spark Plub Div., Flint, Mich.
Gill, R. L. (Re-election), Public Serv. Co. of N. Ill., Joliet, Ill.
Gilmer, J. A., American Tel. & Tel. Co., Chicago, Ill.
Hagren, G. L., Duplex Truck Co., Lansing, Mich.
Hart, J. A., General Motors Corp., Indianapolis, Ind.
Hollingsworth, C. A., Bendix Home Appl., Inc., South Bend, Ind.
Holm, J. P., Commonwealth & Southern Corp., Jackson, Mich.
Marshall, S. C., General Elec. Co., Fort Wayne, Ind.
McCollister, F. W., Dow Chemical Co., Midland, Mich.
McCurley, J. C., James Stewart & Co., Chicago, Ill.
Miskinis, K., Allis-Chalmers Mfg. Co., West Allis, Wis.
Moehl, K. R., Univ. of Mich., Ann Arbor, Mich.
Nolan, F. M., Allis-Chalmers Mfg. Co., West Allis, Wis.
Osburn, C. U., General Elee. Co., Fort Wayne, Ind.
Paalu, A., A. O. Smith Corp., Milwaukee, Wis.
Paulsen, W. E., Public Serv. Co. of Northern Ill., Maywood, Ill.
Potter, J. D., Northwestern Univ., Evanston, Ill.
Prandoni, E. L., Caterpillar Tractor Co., East Peoria, Ill.
Proudfoot, O. P., Cutler-Hammer, Inc., Milwaukee, Wis.
Regensteiner, C., Sargent & Lundy, Chicago, Ill.
Ritter, T. J., Line Material Co., South Milwaukee, Wis.
Schubert, W. C. (Re-election), Hercules Powder Co., Baraboo, Wis.
Sherwin, H. W., Michigan Bell Tel. Co., Detroit, Mich.
Straub, C. L., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Sundstrom, O., Illinois Light Co., East Peoria, Ill.
Takle, K. J., Illinois Inst. of Tech., Chicago, Ill.
Trefry, D. E., Detroit Edison Co., Detroit, Mich.
Waller, J. C., James Stewart Co., Inc., Chicago, Ill.
Willoughby, M. B., Republic Steel Corp., Chicago, Ill.
Wilson, C. H. (Re-election), Gen. Motors Corp., Grand Blanc, Mich.

6. North Central

Eklund, R. A., U. S. Bur. of Reclamation, Cheyenne, Wyo.
Potter, K. W., Public Serv. Co. of Colo., Denver, Colo.
Schacht, R. L., Consumers Pub. Power Dist., Lincoln, Nebr.

7. South West

Coffman, J. P., Kansas Gas & Elec. Co., Parsons, Kans.
Farley, J. C., Jr., Southwestern Power Adm., Denison, Texas.
Fullerton, F. W., Southwestern Bell Tel. Co., Oklahoma City, Okla.
Hankison, W. C., A. T. & S. F. Ry. Western Lines, Amarillo, Texas
Harrison, J. S., Cessna Aircraft Co., Wichita, Kans.
Keller, H., Aluminum Co. of America, Malvern, Ark.
Ketteringham, G. R., North American Aviation, Dallas, Texas.
Klumb, R. E., General Electric Co., St. Louis, Mo.
Laird, J. A., III, Kelly Field, Texas.
Lee, J. L., Gulf, Colorado & Santa Fe Ry. Co., Galveston, Texas.
Moore, R. I., Allis-Chalmers Mfg. Co., Tulsa, Okla.
Moorhouse, E. C., Cessna Aircraft Co., Wichita, Kans.
Nienhaus, E. J., Southwestern Bell Tel. Co., Oklahoma City, Okla.
Spencer, N. C., Gulf States Util. Co., Beaumont, Texas.
Stein, W. A., Washington Univ., St. Louis, Mo.
Whitaker, G. R., Oklahoma Gas & Elec. Co., Oklahoma City, Okla.
Williams, W. F., Jr., Brown Shipbuilding Co., Houston, Texas.
Yoder, H. F., Beech Aircraft Corp., Wichita, Kans.

8. Pacific

Ackerman, J. M., Standard Oil Co. of Calif., San Francisco, Calif.
Adelfson, N. O., U.S.N.R., Winslow, Ariz.
Bennett, C. B., U. S. Naval Repair Base, San Diego, Calif.
Delaney, J. P. (Re-election), Bureau of Pwr. & Lt., Los Angeles, Calif.
Dimitroff, A. Z., Phelps-Dodge Corp., Jerome, Ariz.
Egerman, A. P., U. S. Naval Drydocks, Hunters Point, San Francisco, Calif.
Fore, J. G., Joslyn & Ryan, San Francisco, Calif.
Gilman, H. E., Jr., Smith & Lindstrom, San Francisco, Calif.
Haggard, J. B., General Elec. Co., Los Angeles, Calif.
Harer, W. S., U. S. Navy Yard, Mare Island, Calif.
Hutchings, J. X., U. S. Maritime Comm., Oakland, Calif.
Kenney, R. R., Lockheed Aircraft Corp., Burbank, Calif.
Kirchner, H. J., Douglas Aircraft Co., Inc., Santa Monica, Calif.
Krailo, P., Douglas Aircraft Co., Inc., El Segundo, Calif.
Leicester, J. F., III., Sperry Gyroscope Co., San Francisco, Calif.
Malneritch, J. J., Lockheed Aircraft Corp., Burbank, Calif.
McAdams, L. J., Permanente Metals Corp., Permanente, Calif.
Neikirk, W. T., Line Material Co., San Francisco, Calif.
Rodet, P. M., Dept. of Bldg. & Safety, Los Angeles, Calif.
Ruffin, E. J., Moore Dry Dock Co., Oakland, Calif.
Settle, A. G., Douglas Aircraft Co., El Segundo, Calif.
Shapiro, J. J., U. S. Naval Drydocks, San Francisco, Calif.
Wiedman, E., Southern Calif. Tel. Co., Los Angeles, Calif.

9. North West

Cole, W. L., DuPont Co., Richland, Wash.
Hartling, J. P., Westinghouse Elec. & Mfg. Co., Seattle, Wash.
Johnson, O. J., Boeing Aircraft Co., Seattle, Wash.
Mills, B. C., State College of Wash., Pullman, Wash.
Nelson, E. A., Puget Sound Navy Yard, Bremerton, Wash.
Pearson, H. F., Washington Water Pwr. Co., Spokane, Wash.
Peterson, R. A., Boeing Aircraft Co., Seattle, Wash.
Russell, W. H., U. S. Engineers, Portland, Oreg.

10. Canada

Crawford, H. J., Toronto Trans. Comm., Toronto, Ont., Can.
Eaton, M. (Re-election), Shawinigan Chemicals, Ltd., Shawinigan Falls, Que., Can.
Gardiner, A. H., Can. Gen. Elec. Co., Peterboro, Ont., Can.
Laurence, B. R., Canadian West. Co., Ltd., Hamilton, Ont., Can.
Mathers, F. F., Can. Gen. Elec. Co., Ltd., Peterboro, Ont., Can.
McHenry, G. M., Canadian Gen. Elec. Co., Toronto, Ont., Can.
Nylin, M. E., University of Toronto, Toronto, Ont., Can.
Oldfield, W., Loblaw Groceterias Co. Ltd., Toronto, Ont., Can.
Olsen, E. C., Can. Gen. Elec. Co., Ltd., Peterboro, Ont., Can.
Ratcliffe, L. C., Bell Tel. Co. of Can., Toronto, Ont., Can.
Smith, J. A., Shawinigan Water & Pwr. Co., Shawinigan Falls, Que., Can.
Smith, K. G., R. C. A. Victor Co. Ltd., Montreal, Que, Can.
Thorne, E. C. (Re-election), Dept. of National Defence, Ottawa, Ont., Can.
Wilkinson, H. M., Can. Gen. Elec. Co., Ltd., Peterboro, Ont., Can.

Elsewhere

Aguirre, H. R., General Electric, S. A. Mexico, D. F., Mex.
Ahuja, R. L., Refineria Pemex, Atzcapotzalco, D. F. Mex.
Alfaro, A. D. S., Mexican Lt. & Pwr. Co., Mexico, D. F., Mex.
Arizcorreta, G., Consulting & Sales Engineer, Mexico, D. F., Mex.
Bates, C. R., Ferranti, Ltd., Hollinwood, England.
Cabral, S. G., Mex. Lt. & Pwr. Co., Ltd., Licenciado Verdad, Mex.
Cantu, T. G., Comision Federal Electricidad, Mexico, D. F., Mex.
Cervantes, A. L., Com. Nac. de Irrig., Mexico, D. F., Mex.
Christlieb, A., Cia Mex. De Maquinaria, S. A. Mexico, D. F. Mex.
Christlieb, A. I., Sociedad Electro-Mecanica, Mexico, D. F., Mex.
Davalos, E. O., Mexican Lt. & Pwr. Co., Ltd., Mexico, D. F., Mex.
DeLaTorre, I. G., Petrolees Mexicanes, Poza Rica, Ver., Mex.
del Busto, A. F., Mex. Lt. & Pwr. Co., Ltd., Mexico, D. F., Mex.
Enzastiga, F. V., Mexican Lt. & Pwr., Co., Ltd., Mexico, D. F., Mex.
Fernandez, A. P., Mexican Lt. & Pwr. Co., Ltd., Mexico, D. F., Mex.
Galan, L. G., Pachuca Lt. & Pwr. Co., Mexico, D. F., Mex.
Gall, M. E., Tech. Office, British Admiralty, Cardiff, Wales
Garcia, G. S., Mexican Lt. & Pwr. Co., Mexico, D. F., Mex.
Gordillo, E. A., Refineria Pemex, Atzcapotzalco, D. F., Mex.
Lagarde, J. V., Cia Dist. Westinghouse, S. A., Mexico, D. F., Mex.
Llanos Manduley, R., Cuban Tel. Co., Havana, Cuba.
Lomas, L. E. M., Mexican Government Rwy. Const. Dept., Mexico, D. F., Mex.
Martinez, E. C., Air Conditioning Contractor, Mexico, D. F.,Mex.
Martinez, H. D., Nac. Financiera, S. A., Mexico, D. F., Mex.
Meyer, C. A., Cia. Dist. Westinghouse, S. A., Mexico, D. F., Mex.
O'ccelli, A. S., Lerma Project, Mexico, D. F.,Mex.
Ochoa, C. F. del C., Com. Nac. de Irrig., Mexico, D. F., Mex.
Plasencia, A. O., City's Council of Guadalajara, Jal., Mex.
Rexach, W. S., School of Tropical Medicine, San Juan, P. R.
Rodriguez, F. A., Mexican Lt. & Pwr. Co., Mexico, D. F., Mex.
Rojas, M. A., Refineria Pemex, Atzocapotzalco, D. F., Mex.
Ruiz, A. de S., Impulsora de Empresas Electricas, Mexico, D. F., Mex.
Ruiz, A. R., Mexican Lt. & Pwr. Co., Mexico, D. F., Mex.
Schmill, J. V., Mexican Lt. & Pwr. Co., Ltd., Mexico, D. F., Mex.
Solis, J. S., Westinghouse Elect. Intl., Monterrey, N. L., Mex.
Soto, E. S., P. R. Water Resources Auth., Muyaguez, P. R.
Tattersfield, J. P., Babcock & Wilson, Ltd., Mexico, D. F., Mex.
Tello, C. M., General Supply Co., Mexico, D. F., Mex.
Uruchurtu, J. A. Gil, Com. Nac. de Irrig., Mexico, D. F., Mex.
Valentin, J., Mexican Lt. & Pwr. Co., Mexico, D. F., Mex.
Vargas, L. Z., CIA Impulcora de Empr. El. S. A., Mexico, D. F., Mex.
Vidal, F. H., Com. Nac. de Irrig., Mexico, D. F., Mex.
Viegas, F., Brush Elect. Engg. Co., Ltd., Loughborough-Lines, England.
Voss, J. F., Panama Canal, Balboa, C. Z.

Total to grade of Associate
United States and Canada 299
Elsewhere 44

OF CURRENT INTEREST

Professional Engineering Act Held Unconstitutional

The Illinois Professional Engineering Act passed by the state legislature in 1941 and containing many of the provisions of the "model law" developed by the American Society of Civil Engineers and other societies was declared unconstitutional by Judge Victor Hemphill in the Circuit Court of Sangamon County, Ill., on November 23, 1943. The case is under appeal to the Illinois Supreme Court and hearing has been set for the March 1944 term.

The major grounds of Judge Hemphill's ruling apply to the law's definition of professional engineering which corresponds to that proposed by the "model law" and those already incorporated into the laws of about 20 states. According to his opinion:

> If the act leaves to ministerial officers the definition of the thing to which the act is to be applied, such definition not being commonly known, it is invalid as an unwarranted delegation of power.

The opinion further states that such delegation of power is void and goes on to say that the legislature has not told the Department of Registration and Education, the administrative agent, what services require the application of engineering principles and data or what services involve public welfare, life, health, or property. The clause exempting "other recognized professions or trades" also was singled out as unconstitutional.

Although the action, if allowed to stand in Illinois, has no direct bearing on the laws in other states, it would serve as sufficient precedent for other suits in states having the same definition and similar constitutions.

The Illinois law was to become effective in August 1943, and suit was brought in July 1943 by a manufacturer of screens to restrain the director of the Department of Registration and Education from enforcing the act. It was defended by the Attorney General of the State, and the Illinois Engineering Council employed counsel who appeared as friend of the court. In the appeal to the Supreme Court, the Engineering Council has been granted leave to intervene as a defendant.

INDUSTRY

Brazil Increases Motor Production

The electric motor industry in Brazil has increased production more than 100 per cent each year since 1940. This year Brazil expects to produce locally two thirds of the electric motors needed to meet domestic requirements and hopes to import the other one third from the United States. Prior to the war, Germany supplied 37 per cent of the Brazilian market, and the United States contributed 40 per cent.

At present there is great demand for motors to operate machine tools, pumps, compressors, and refrigerating equipment. Polyphase motors from $^{1}/_{2}$ to 50 horsepower are practically the only type of motor produced, however, and the cost ranges from 25 to 100 per cent higher than that of the United States product. Thus, it is expected that at the close of the war there will be a market in Brazil for fractional-horsepower single-phase motors for domestic and industrial appliances, and for large industrial polyphase types for operating machinery and supplying motive force to such industries as sugar mills, mines, canneries and vegetable-oil mills, paper mills, and metallurgical industries.

Changes Announced in Bureau of Standards Frequency Broadcast

Two changes are announced in the standard-frequency broadcast service of the National Bureau of Standards: the addition of a new radio frequency, 2,500 kilocycles per second, at night; and the omission of the pulse on the 59th second of every minute. The service comprises the broadcasting of standard frequencies and standard time intervals from the bureau's radio station WWV near Washington, D. C., continuously day and night (*EE, Sept '43, pp 424–5*).

There is on all carrier frequencies a pulse of 0.005-second duration which occurs periodically at intervals of precisely one second. The pulse consists of five cycles, each of 0.001-second duration and is heard as a faint tick when one is listening to the broadcast. It provides a useful standard of time interval for purposes of physical measurements and may be used as an accurate time signal. The pulse for the 59th second of every minute is now omitted.

North American Philips Company Opens Laboratory

Establishment of a new electronics laboratory at Irvington, N. Y., recently was announced by Pieter van den Berg, vice-president and general manager of North American Philips Company, New York, N. Y. The appointment of O. S. Duffendach, formerly professor of physics, University of Michigan, as research director of the laboratory was announced simultaneously.

The laboratory is part of the company's plans for extending its activities in the electronics field, and fundamental research in chemistry and physics is contemplated. At present the North American Philips Company is continuing, with reduced numbers of products, the manufacture of the specialties which built up the Philips Company in Eindhoven, Holland, before the war, when it manufactured lighting, radio, television, X-ray, and sound-film equipment, and metallurgical, glass, and plastics products. Production of quartz crystals, oscillator plates, cathode-ray tubes, X-ray equipment, tubes, fine wire, tungsten and molybdenum products, and other electronic devices have occupied the North American company, since it was incorporated in 1942 under the laws of Delaware, in an effort to make full use in the war program of all the resources, management, and engineering personnel; technical knowledge; and funds which it has accumulated since the Philips Company was founded in 1891 in Holland. Before the war 45,000 persons were employed by the company throughout the world, 20,000 of them in Holland.

Mr. van den Berg emphasized the fact that the North American company will endeavor "to earn a worthy place in the ranks of manufacturers of industrial electronics equipment in America. It will always be an American company and will not be dependent on help from outsiders in its development."

In addition he pointed out that after the war the North American company would have the asset of being able to draw upon all the technical resources of Philips companies in Holland and elsewhere and to call on associated plants in England, Australia, New Zealand, and South America for co-operation.

New D-C Resistance Welder Uses Storage Batteries

A d-c resistance welder using storage batteries as a source of welding current has been produced by Progressive Welder Company, Detroit, Mich., and is now in use welding aluminum for aircraft assemblies. The use of batteries as a source of stored energy makes possible the application of resistance welding in localities where power-supply limitations have prevented the use of other forms of stored-energy welders. The only requirement is sufficient power to operate a battery charger. Compared with other forms of stored-energy welders, the use of batteries for the power source means a material reduction not only in initial cost of the welding installation but also in operating costs, particularly in current consumption, maintenance costs, and supervisory requirements. The simplicity of the contactor-controller and the elimination of transformers, synchronous heat controls, and so forth, make it possible to maintain the equipment with only a normal amount of mechanical skill, it is claimed.

120,000-Rpm Motor Developed

An electric motor operating at the speed of 120,000 rpm has been developed by General Electric Company for application to internal grinding machines used in finish-grinding small holes, many less than one-quarter inch in diameter, in vital war parts. It may also be used to drive small drill chucks for drilling tiny holes in soft metals, using drills $^{1}/_{32}$ inch in diameter or less. The motor will not be available for general use until after the war.

With normal voltage applied at 2,000 cycles, the motor reaches full speed in less than a second. It is rated three horsepower and weighs but seven pounds as contrasted with the standard three-horsepower 1,800-rpm motor which weighs 105 pounds. The motor is so small that it fits into the palm of a person's hand, and its rotor is scarcely larger than a man's thumb. Tests the motor has passed successfully at 120,000 rpm include eight-hour continuous runs at rated horsepower as well as grinding tests with a tiny grinding wheel mounted directly on the motor shaft.

Problems entering into the design of the motor were chiefly of a mechanical nature. Since the utmost in smooth operation is an essential to precision grinding, ultraprecision bearings with practically perfect dynamic balance were required. A special oil-mist lubricated type of bearing is used. The amount of material used in the motor is so small, with a consequent reduction in radiating surface, that water cooling is utilized, one-half gallon a minute being used.

Brazil's New National Motor Factory Begins Production

Brazil's fastest-growing most modern factory, the National Motor Factory, which was scheduled to begin production early in January 1944, will be the first plant in Latin America to build airplane engines from start to finish. Located in the foothills of the Serro do Mar mountains about 22 miles from Rio de Janeiro and near the main line of the railroad running between Rio de Janeiro and Petropolis, the $9,000,000 plant will soon be producing enough engines and parts from Brazilian resources to help power United Nations' aircraft.

Largely responsible for the conception and development of the National Motor Factory is Air Brigadier Antonio Guedes Muniz of the Brazilian Air Force, who realized that, because of her vast area and varied terrain, Brazil's transportation future would entail increasing use of aviation services. When war came to the Americas the military importance of such a plant became evident, and immediate construction of the National Motor Factory became vital to the defense of the Western Hemisphere.

Although plans for the factory began taking shape in 1940 when General Muniz, then an Air Force colonel, was sent on a two-month government survey trip to select a suitable factory site, there had to be many conferences between Brazil and the United States as to authorization and financing of the project before approval was satisfactorily concluded, and actual construction did not get under way until July 1942. In the interim, progress was halted, because many priorities on machinery could not be honored in the face of a developing critical world situation, and then resumed when it was agreed that the factory would be included in the United States Lend–Lease assistance to Brazil. After American experts changed the plant design somewhat, a contract was signed with the Wright Aeronautical Corporation, authorizing the manufacture in Brazil of the Wright Whirlwind 450-horsepower airplane engine.

Since 1942, the project has been rushed to swift completion. The 700-foot-long windowless factory building has been fully equipped with air conditioning and fluorescent lighting. Like other Brazilian structures, it is made of reinforced concrete, and to maintain thermal control in the building the roof is lined with soft natural sand from northern Brazil. Its equipment is all-American of the very latest type, and the plant design and methods of production have been and will be patterned closely on the North American model.

Emphasis at the National Motor Factory is on an overhead power system, with the machinery not bolted to the floor, to facilitate future movement. An electrical control station with a view dominating the entire internal plant area will centralize factory control in one man. Crankcases and aluminum parts will be made on one side of the factory, while steel parts and crankshafts are being fabricated on the other side. Castings will be fed into the plant from the aluminum and brass foundry that is fast taking shape.

Brazilian engineers are now studying at the Wright plant in Paterson, N. J. Upon returning to Brazil, aided by North American experts they will teach 1,000 specially selected workmen in the craft of engine building. Top production for the plant has been estimated at more than 500 Wright Whirlwinds a year on one eight-hour shift and twice that for two shifts. Later it is expected that the plant will build plane engines up to 1,200 horsepower.

General Muniz foresees vast technological changes for Brazil arising from the operation of the National Motor Factory. He said: "This factory will show Brazilians new techniques in making mechanical parts and in erecting factories on the American, not the European, design. . . For the first time we will be using the finest American precision tools on a large scale. Heretofore, Brazilian manufacturers have been inclined to buy British and German machine tools, since they were slightly cheaper than the American ones. This war, however, is showing each day that American tools have not only unsurpassed quantity output but also unmatchable quality. Once Brazilians see for themselves how these instruments work, they will be content with no other."

Postwar Foreign Markets for U. S. Electrical Goods Estimated

In a statistical study and project recently made by the Bureau of Foreign and Domestic Commerce, "Foreign Trade After the War," attempt has been made to appraise the probable magnitude and distribution of foreign markets for postwar electrical goods.

The percentage of United States production reaching foreign markets is uncertain, since the amount of electrical devices incorporated in machines and equipment may add one third to one half to the total, but it varies usually from two to four per cent of production. In the past, American manufacturers have shared less in the foreign markets in proportion to their production than any other country, but this proportion is expected to increase.

In the present survey, the projects and plans for expansion in foreign countries were tabulated, and the percentage which may be filled from the United States was estimated. Since all calculations were based on probable rather than actual statistics, the results are largely hypothetical, but if the conditions assumed by the report are reached and the total exports of electrical goods in 1948 amount to $195,000,000 as was estimated, then the distribution indicated in the accompanying table will be a possibility.

Table I. United States Export Percentage of Electrical Goods for 1948 Foreign Markets

Types of Equipment	Millions of Dollars
Generators, converters, arc-welding and generator parts and accessories	14.0
Primary batteries	5.3
Secondary batteries	5.0
Transformers	6.3
Power switches, lighning arresters, etc	4.0
Power switchboards	2.0
Meters and testing equipment	6.5
Motors and parts	20.0
Motor controls	4.0
Electric locomotives	2.0
Station and warehouse trucks	.4
Portable electric tools	2.0
Electric lamps	2.0
Lighting fixtures	5.0
Electric refrigerators	24.0
Other motor-driven household appliances	7.5
Domestic heating appliances	2.0
Industrial electric furnaces	2.0
X-ray and therapeutic apparatus	3.5
Radio-transmitting and receiving apparatus	33.0
Wire-communication apparatus	6.0
Wiring devices	7.5
Other electrical appliances	31.0
Total	195.0

Slide Rule Checks Size of Circuit Breakers. A slide rule which offers a simplified means of determining the correct-size air circuit breakers for industrial substation applications has been made available by Allis-Chalmers Manufacturing Company. With this "unit-sub rule," one can calculate the interrupting capacity of the 600-volt class air circuit breakers needed for control of power in all industrial plants. The rule has been constructed from standard AIEE formulas for determining short-circuit currents and takes into consideration necessary factors, such as motor load and d-c component. The engineering information given in the rule is available also in nomogram form in the manufacturer's unit substation bulletin *B*6285. Write Allis-Chalmers Manufacturing Company, Milwaukee, Wis., for the slide rule or bulletin.

WAR PROGRAM • •

X Ray Locates Foreign Bodies on Horizontal and Vertical Planes

The biplane marker and reorientation device, a field-hospital X ray, which localizes slugs and fragments in wounded men in two planes, vertical and horizontal, and makes it possible for surgery to be performed without moving the patient, has been designed by engineers of Westinghouse Electric and Manufacturing Company, according to announcement by Colonel Alfred A. de Lori-

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Abstracted from "Brazil's New National Motor Factory," by the Office of the Coordinator of Inter-American Affairs, *Foreign Commerce Weekly*, December 25, 1943.

mier, commandant of the Army's school of roentgenology. The device not only locates foreign bodies but marks the wounded man with iodine to guide the surgeon in making an accurate incision.

The X-ray division of the Westinghouse Electric and Manufacturing Company, Baltimore, Md., has been awarded an Army contract for almost 2,000 of these devices, which will be put into service on the fighting fronts.

WPB and Labor Department Plan Safety Campaign

An antiaccident agreement has been announced by the War Production Board and the Department of Labor through which the two agencies will pool their forces to reduce the toll of industrial accidents that result annually in a loss of life six times as great as the Nation sustained at Pearl Harbor.

In announcing the antiaccident agreement, WPB Chairman Donald M. Nelson said:

> In 1943, 56,800,000 man-days were lost from essential production, and 18,400 workers died because of industrial accidents. This vital blow at America's war production goes unrecognized by too many of us who were shocked into instant action by the loss of 3,303 lives among our Armed Forces at Pearl Harbor. Such a defeat on the production line cripples our war effort just as certainly as a major military defeat in the field.

The agreement between the WPB office of labor production and the Labor Department's division of labor standards is a step toward carrying out the comprehensive antiaccident campaign launched recently by WPB, in co-operation with various federal agencies, labor unions, industrial groups, and other private organizations. Among the groups participating in the campaign are American Federation of Labor, Congress of Industrial Organizations, United States Chamber of Commerce, National Association of Manufacturers, and National Safety Council.

The administration of the antiaccident campaign within WPB is being handled by the industrial health and safety section of the Office of Labor Production, headed by WPB Vice-Chairman Joseph D. Keenan. The agreement between WPB and the Labor Department will facilitate utilization by WPB of the nation-wide field staff and facilities of the division of labor standards. The staff of the division of labor standards consists of 22 full-time safety engineers and 600 volunteer special agents.

Under the terms of the agreement, the industrial health and safety section of the WPB labor production office will carry out such functions as follows:

1. Receive reports, suggestions, and complaints dealing with the industrial hygiene and the safety of war workers.
2. Act as a central clearing house in the War Production Board to check and refer these data for remedial action by the proper Federal agencies operating in the field of health and safety.
3. See that labor unions, management, and labor–management committees avail themselves of educational material on health and safety in general or in relation to particular industries.
4. Work with Government agencies and with labor and management to ensure that local labor and management representatives co-operate with Federal and State agencies in developing and executing remedial health and safety programs in designated critical war-industry areas.

The agreement provides that the safety and health branch of the Department of Labor's division of labor standards carry out the following activities:

1. Co-operate with management, labor, state labor departments, the American Standards Association, and other safety agencies in drafting safety codes and regulations.
2. Analyze and serve as a central clearing house for information on safety laws and regulations and their administration.
3. Prepare and publish pamphlets, leaflets, and posters on industrial safety and health.
4. In co-operation with the United States Office of Education, conduct training courses for supervisory personnel and for safety representatives of unions.

Industry Urged to Renew Scrap Iron and Steel Contributions

An urgent appeal is being made to industry to step up its collection of industrial scrap. Although industry has responded magnificently to the national scrap drive in the past, a round-the-world war requires a constant, round-the-clock scrap support. Vast quantities of iron and steel scrap are still available, and in industry, especially, there exists the heavy scrap that is so much needed.

Industrial-salvage officials of the War Production Board have observed a steady dangerous downward trend in reports of dealers' scrap iron and steel inventories during the past year. According to a comparison breakdown by the United States Bureau of Mines covering a period from October 1942 through September 1943, shipments of heavy iron and steel scrap declined from 498,787 to 235,840 gross tons—a total of more than one half within eleven months.

Robert W. Wolcott, chairman of the American Industries Salvage Committee, declares that the normal spring increase in inventory cannot be expected, as the difficulty in the lack of man-power, transportation, and collection facilities now evident will only be accentuated. What remains is for industry to re-examine its assets of capital goods—to take another look, and to keep looking—for further opportunities of providing scrap iron and steel for imperative production demands.

"Salvage Manual for Industry," a 244-page volume recently published by the technical service section of the industrial-salvage branch of the WPB, is being distributed to executives interested in taking advantage of its suggestions for conducting a thoroughgoing scrap and salvage campaign. Copies of the manual can be purchased from the Superintendent of Documents, Washington, D. C., for 50 cents each.

In addition to the other considerations which may determine whether or not a piece of machinery or some of its parts should be scrapped, the Business Press Industrial Scrap Committee calls attention to the fact that industrial plants may claim a tax deduction on obsolete machinery, tools, and equipment consigned to the scrap pile. The Treasury Department, in general, has made allowance for losses sustained as a result of scrap and salvage operations. The theory of this application is that any taxpayer who scraps a capital asset is entitled to a deduction equal to the difference between the depreciated cost of the asset and its salvage value. Management has also been advised of the soundness of segregating its gross tonnage of scrap so as to realize full replacement value on the usable materials, and full cash and refund value on the segregated and prepared tons of scrap.

OTHER SOCIETIES •

Midwest Power Conference to Be Held April 13–14

War and postwar problems will keynote the seventh annual Midwest Power Conference, arranged by Illinois Institute of Technology, which will be held April 13 and 14 at the Palmer House, Chicago, Ill., according to announcement by Stanton E. Winston, acting head of the mechanical-engineering department at Illinois Institute and director of the conference.

The conference which will feature the theme, "Power Brings Victory," will include three electrical meetings and sessions on power-plant practice, industrial power plants, plant maintenance, fuels, and Diesel power. Among the speakers will be Alex D. Bailey, assistant to the vice-president of Commonwealth Edison Company, Chicago, who will speak on "Postwar Planning of the Nation's Power Supply," and J. A. Krug, director of the office of war utilities of the War Production Board, Washington, D. C.

AIEE and American Society of Mechanical Engineers will each sponsor a conference luncheon. Speakers at these sessions will be B. W. Clark, vice-president in charge of sales, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., and C. O. Dohrenwend, chairman of engineering mechanics research at the Armour Research Foundation, Illinois Institute of Technology, Chicago.

The eight engineering societies included in the planning and sponsoring are: Chicago sections of American Institute of Chemical Engineers, AIEE, American Institute of Mechanical Engineers, ASME, Illinois sections of American Society of Civil Engineers and American Society of Heating and Ventilating Engineers, Western Society of Engineers, and Engineers' Society of Milwaukee. Schools working with Illinois Institute in sponsoring the conference include: Iowa and Michigan State Colleges, and Northwestern, Purdue, Iowa, Illinois, Michigan, and Minnesota universities.

List of Process Control Terms Issued by ASME

A revised list of process control terms and definitions has been prepared by the terminology committee of the industrial instruments and regulators division of American Society of Mechanical Engineers and will be presented for adoption by the division after all interested persons have had an opportunity to study the terms and offer comments. The list comprises a total of 45 definitions classified under five headings: general automatic control terms; types of automatic controller action; elements of automatic controllers; terms related to controller adjustment; and basic characteristics and elements.

All those interested, regardless of affiliaon, are urged to send suggestions and iticisms before June 15 to H. F. Moore, airman, terminology committee; industal instruments and regulators division, SME; Post Office Box 37, Elizabeth, N. J. riticisms of the list should be accompanied specific suggested changes, insofar as ossible. Reprints of the list, which is being iblished in the March issue of *Mechanical igineering* may be obtained from ASME, West 39th Street, New York 18, N. Y., on request.

ational Safety Council Offers Service for Small Organizations

The National Safety Council announces a w membership service designed exclusively fit the needs of industrial organizations th 100 employees or less.

A recent survey of hundreds of industrial ganizations in this size group, covering ven different industries, showed that the erage accident frequency rate for these ganizations was 47 per cent higher than e average for the largest organizations in e same industries, according to Ned H. earborn, executive vice-president of the uncil. In every industry studied the avere frequency rate for small organizations, every case, was higher than the average for e entire industry, he said.

The small-unit memberships will include e following services:

A safety manual on what management should know out organization and operation of an industrial safety ogram.

Supplies of accident prevention charts and safety pection check lists.

Monthly poster service with selections made espelly for small-unit operations.

Master copy of a "letter to employees" on a timely ety subject, the letter to be reproduced, signed, and tributed in the way the member feels is most effective.

Monthly issue of a safety instruction poster.

A year's subscription to *National Safety News*, cial magazine for Council members which will conn a section devoted exclusively to the problems of s type of member.

In community council localities the memr will, in effect, get two memberships in e—his community safety council, and a ecial membership in the national organizan. In localities where community safety uncils exist, the new memberships will be cepted exclusively through them. In areas t served by community councils, inquiries ould be directed to the National Safety uncil, 20 North Wacker Drive, Chicago, Ill.

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ture Meetings of Other Societies

erican Society for Testing Materials. Spring meet-, March 1–2, 1944, Cincinnati, Ohio; 47th annual eting, June 26–30, 1944, New York, N. Y.

erican Society of Mechanical Engineers. Spring eting, April 3–5, 1944, Birmingham, Ala. Semiual meeting, June 19–20, 1944, Pittsburgh, Pa.

ctrochemical Society. Spring meeting, April 12–15, 4, Milwaukee, Wis.

lwest Power Conference. April 13–14, 1944, cago, Ill.

ional Electrical Manufacturers' Association. il 23–7, 1944, Chicago, Ill.

ional Fire Protection Association. May 8–11, 4, Philadelphia, Pa.

EDUCATION . . .

Stevens Institute Organizes Foundation for Research Purposes

Organization of the Stevens Research Foundation, a nonprofit corporation to carry on scientific and industrial research in co-operation with Stevens Institute of Technology, was announced recently by Harvey N. Davis, president of the college. The stipulated purposes of the Foundation are to test and develop the public, scientific, and commercial value of inventions, discoveries, and processes and to aid in obtaining patents.

The foundation is an outgrowth of the program of research that Stevens Institute has carried on in recent years which has expanded greatly during the war. Several of its laboratories are now engaged in confidential research for Government departments to aid the war effort, and they have also helped industry to increase and improve production. The Foundation will aim to help meet the new demands of the reconstruction era, including new products, new uses for old products, and new and improved manufacturing processes, after the war.

It is expected that the Foundation will concentrate on fundamental problems which may take several years to solve and which are of general interest and value to the public, to industry, and to government. Publications on the results of studies and experiments are contemplated. Research will be carried out independently and in co-operation with Stevens Institute and with industries and other agencies, institutions, and organizations under definite contracts. The first concrete projects under the research foundation will be those already existing or planned—powder metallurgy, towing tank projects, sound research, and others.

James McKeen Cattell, psychologist, and scientific editor and author, died January 20, 1944. Dr. Cattell, who held the world's first professorship in psychology at the University of Pennsylvania from 1888 to 1891, was born in Easton, Pa., May 25, 1860. After graduating from Lafayette College in 1880, he studied at Gottingen, Leipzig, Paris, Geneva, and Johns Hopkins University. Subsequently he taught at Bryn Mawr College and Columbia University. In later years he edited the *Psychological Review*, the *Scientific Monthly*, *School and Society*, *the American Naturalist*, American Men of Science, and Leaders in Education and was president of the Science Service which supplies scientific articles to newspapers. He was a firm believer in the value to society of psychological aptitude tests and his strong convictions on academic freedom more than once engaged him in controversy. He believed that the scientist was destined to be in the forefront of international co-operation. He held numerous honorary degrees and memberships in scientific societies. In 1923 he was awarded the gold medal of the Society of Arts and Sciences.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

Practical Education in Wartime

To the Editor:

Philip W. Swain's article, "Practical Education in Wartime" (*EE, Dec '43, pp 534–7*) struck a responsive chord, because I, too, have found that reviewing a subject by the "primer" method has advantages. I am in agreement with the author's contention that one can learn a great deal more, and faster, from a "primer" than from the usual text. Especially is this so if one must sandwich his study of such a book in among the many other demands of a busy day.

I am in the process of completing such a "beginner's" book, and it seems as though I have learned a great deal more about the subject than I can remember from my previous contact through a college text. As Mr. Swain points out, "such books often are written with more care and skill than those directed toward more advanced students." Also, I have found that some of the books have detailed problem solutions with answers accompanying all the practice problems. Why so many engineering textbooks are published without answers remains a mystery to me.

When a person is attempting to "brush up" on some past college course, or perhaps is endeavoring to work out a problem in a strange field, he is no longer interested in merely copying an answer but is seriously concerned with learning the mechanics of working out the solution to his problem. One of the best ways I have found, especially in involved electrical problems, is to follow through some problem worked out in a textbook. If one gets the same answer, he can feel fairly certain he has followed the right method. Without such a guide one cannot always be sure he is using the right approach.

From my experience in searching for "brush-up" books there appears to me to be a need for good "primers" in many lines, and I believe such books would be far more valuable for individual study if detailed problem solutions and practice-problem answers were included.

CARL R. ALBACH (A'43)

(Assistant engineer, design and estimating department, United States Engineers District Office, Kenmore, N. Y.)

NEW BOOKS • • •

The following new books are among those recently received from the publishers. Books designated ESL are available at the Engineering Societies Library; these and thousands of other technical books may be borrowed from the library by mail by AIEE members. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books. All inquiries relating to the purchase of any book reviewed in these columns should be addressed to the publisher of the book in question.

Steel Man in India. By J. L. Keenan with the collaboration of L. Sorsby; introduction by L. Bromfield. Duell, Sloan and Pearce, Inc., New York, N. Y., 1943. 224 pages, $8^1/_2$ by $5^1/_2$ inches, cloth, $2.50. (ESL.)

This autobiographical narrative covers the experiences of an American steel man during 25 years with the largest steel-producing unit in India. Technical details, humorous reminiscence, and social and political discussion are intermixed throughout the book, giving an over-all picture of the development of the industrial age in India.

Plastics. By J. H. DuBois. American Technical Society, Chicago, Ill., 1943. 435 pages, illustrated, $8^1/_2$ by $5^1/_2$ inches, cloth, $3.75. (ESL.)

This is a simplified presentation of the manufacture and use of the important plastic materials and products, with tables of their properties and the basic information required by engineers and designers. The revised edition contains two new chapters on synthetic rubber and low-pressure laminates. The book is designed to be used both as a text and as a practical reference handbook.

Short Wave Wireless Communication. By A. W. Ladner and C. R. Stoner. Fourth Edition revised and enlarged, John Wiley and Sons, New York, N. Y.; Chapman and Hall, London, England, 1943. 573 pages, illustrated, $8^3/_4$ by $5^1/_2$ inches, cloth, $6. (ESL.)

Although this book deals especially with short-wave communication, the principles common to both long and short waves are introduced where necessary in order to achieve a self-contained treatise. The principles and equipment for short- and ultrashort-wave operation are discussed thoroughly in combination, instead of a separate chapter being devoted to ultrashort waves as in previous editions. A chapter on high-frequency therapeutic apparatus is included.

Industrial Safety. By T. O. Armstrong, R. P. Blake, J. J. Bloomfield, C. B. Boulet, M. A. Gimbel, S. W. Homan, W. D. Keefer, and R. T. Page, edited by R. P. Blake, foreword by H. T. Heald. Prentice Hall, Inc., New York, N. Y., 1943. 435 pages, illustrated $9^1/_2$ by 6 inches, cloth, $5. (ESL.)

A series of chapters by authorities in the field provides a handbook useful to all industries. Subjects discussed include the history of industrial safety, causes of industrial accidents, accident prevention, inspection, safeguarding machinery, safety training and education, accident hazards, reports, and records. Fire prevention, first aid, and personal protective equipment are also covered in separate chapters. The book has been written from the viewpoint of the industrial worker on the job.

Luminescence of Liquids and Solids. By P. Pringsheim and M. Vogel. Interscience Publishers, New York, N. Y., 1943. 201 pages, illustrated, $9^1/_4$ by 6 inches, cloth, $4. (ESL.)

Part I of this volume deals with the physics of luminescence, covering the theoretical background, experimental technique, and the properties of luminescent materials. Part II considers critically two main fields of application: fluorescence analysis for identification purposes, and luminescence of various types as light sources. A tabulated list of important fluorescent materials concludes the book.

Machinery's Handbook. By E. Oberg and F. D. Jones. 12th edition. Industrial Press, New York, N. Y.; sole distributors for the British Empire: Machinery Publishing Company, Ltd., 17 Marine Parade, Brighton, England, 1943. 1815 pages, illustrated, 7 by 5 inches, fabrikoid, $6. (ESL.)

In the 30 years since this work first appeared, it has become established as an almost indispensable work of reference in drafting rooms and machine shops. This new edition contains the same number of pages as the preceding one, but numerous changes have been made in charts and tables which bring them up to date.

Handbook of Tabular Presentation. By R. O. Hall. Ronald Press Company, New York, N. Y., 1943. 112 pages, illustrated, $11^1/_2$ by $8^1/_2$ inches, cloth, $3.50. (ESL.)

The designing and editing of statistical tables are discussed on the basis of broad practical experience in this book which will be useful to all who have to present data in tabular form. The principles presented are illustrated by a collection of tables which are discussed critically.

Fundamentals of Electrochemistry and Electrodeposition. By S. Glasstone. American Electroplaters' Society, New York, N. Y., 1943. 90 pages, tables, $8^1/_4$ by 5 inches, fabrikoid, $2. (ESL.)

The 20 chapters composing this small book are a reprinting of a series of articles which appeared in the *Monthly Review* of the American Electroplaters' Society. They describe in fairly simple language the fundamentals of electrochemistry as applicable to electroplating. The last chapter deals briefly with the causes and prevention of corrosion.

Double-Speed Synchronous Generator. (University of California Publications in Engineering, volume four, number three, pages 27–36.) By A. Tilles. University of California Press, Berkeley and Los Angeles, 1943. Illustrated, 11 by $8^1/_2$ inches, paper, 25 cents. (ESL.)

A method is presented of operating a machine as a synchronous machine at twice its ordinary synchronous speed. The basic operating characteristics are given, and the behavior of the machine as a part of a system and in commercial application is indicated in a general way.

ASTM Standards on Paper and Paper Products. Prepared by ASTM committee *D*-6 on paper and paper products: Methods of Testing, Specifications. American Society for Testing Materials, Philadelphia 2, Pa., 1943. 138 pages, illustrated, 9 by 6 inche paper, $1.35 ($1.00 to ASTM members).

ASTM Standards on Plastics. Sponsore by ASTM committee D-20 on plastic specifications, methods of testing, nomenclature, definitions. 1943. 431 pages, illustrated, 9 by 6 inches, paper, $2 ($1.50 t ASTM members).

ASTM Standards on Textile Materia (with related information). Prepared b ASTM committee *D*-13 on textile material specifications, tolerances, methods of testin definitions and terms. 1943. 457 page illustrated, 9 by 6 inches, paper, $2.2 ($1.50 to ASTM members). (ESL.)

These three publications are intended primarily to present in convenient form th ASTM standard and tentative standar methods of test and specifications pertainin to their respective subjects. Glossaries an descriptive nomenclature are included fo the plastics and textile materials, and in th textile-materials volume abstracts are printe of three papers presented at a recent meetin

PAMPHLETS • • • •

The following recently issued pamphlets may b of interest to readers of "Electrical Engineering. All inquiries should be addressed to the issuer

November 1943 Supplement to the Ma 1943 List of Inspected Electrical Equipment. Underwriters' Laboratories, Inc. 207 East Ohio Street, Chicago 11, Ill. 55 pages.

Wage Incentives in Wartime. Consolidated Management Consultants, 521 Fift Avenue, New York 17, N. Y., 47 pages.

The First Five Years Under the Natura Gas Act. Federal Power Commissio Washington, D. C., 24 pages, no charge.

Guide to Postwar Sales Planning. National Association of Manufacturers, 14 Wes 49th Street, New York 20, N. Y., 14 pages.

Guide to Internal Organization for Corporation Postwar Planning. Nationa Association of Manufacturers, 14 West 49t Street, New York 20, N. Y., 14 pages.

United States Production, Consumptio and Stocks of Chemicals 1941–43. Chemicals Bureau, War Production Board, Burea of the Census, Washington 25, D. C., 4 pages.

How Steel Castings are Serving Americ at War. Steel Founders' Society of Americ 920 Midland Building, Cleveland, Ohi 20 pages.

Mechanical Feed Water Regulation fo Boilers. E. P. Culver, Northern Equipme Company, 1945 Grove Drive, Erie, Pa no charge.

Jobs in Peacetime. National Association Manufacturers, 14 West 49th Street, Ne York 20, N. Y., 18 pages.